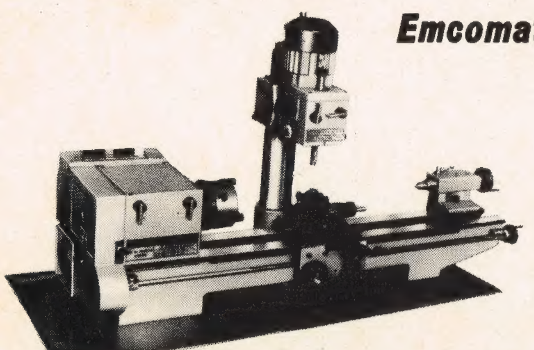
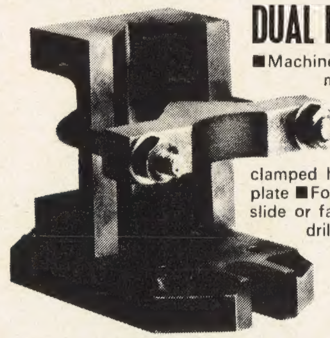
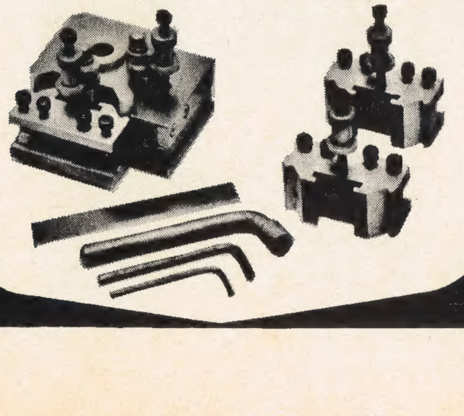
18-31 APRIL 1975 First and Third Friday Volume 141 Number 3511 25p

Model Engineer

(USA & CANADA $1.25)
MAP HOBBY MAGAZINE







Model Engineer

Founded 1898

Incorporating Mechanics and English Mechanics and Ships and Ship Models

Volume 141 Number 3511

April 18th, 1975

CONTENTS

Second-class postage rates paid at New York, U.S.A. Registered at the Post Office for transmission by Canadian Post. American enquiries regarding news stand sales and advertising should be sent to MODEL ENGINEER, Eastern News Distributors Inc., 155 West 15th Street, N.Y. 10011.

MODEL & ALLIED PUBLICATIONS LTD

COVER PICTURE

A $7\frac{1}{4}$ in. gauge L.M.S. "Black Five" 4-6-0 to the "Highlander" design, by W. T. Marks.

NEXT ISSUE

Making small injectors. Models of water-wheels.

Subscription department:
Remittances to **Model & Allied Publications Ltd.,** P.O. Box 35, Hemel Hempstead, Herts. HP1 1EE. (Subscription Queries Tel: **Kings Langley** 66846.) Subscription Rate £7.60, Overseas Sterling £8.00, U.S.A. and Canada $20.00) post free, index included.

Editorial and Advertisement Offices:
P.O. Box 35,
Hemel Hempstead, Herts. HP1 1EE,
Hemel Hempstead 2501-2-3

ABC
MEMBER OF THE AUDIT BUREAU OF CIRCULATIONS

Also published by MAP:— Aeromodeller; Model Boats; Radio Control Models & Electronics; Model Railways; Scale Models; Military Modelling; Woodworker.

'Prices quoted are those prevailing at press date and are subject to alteration due to economic conditions.'

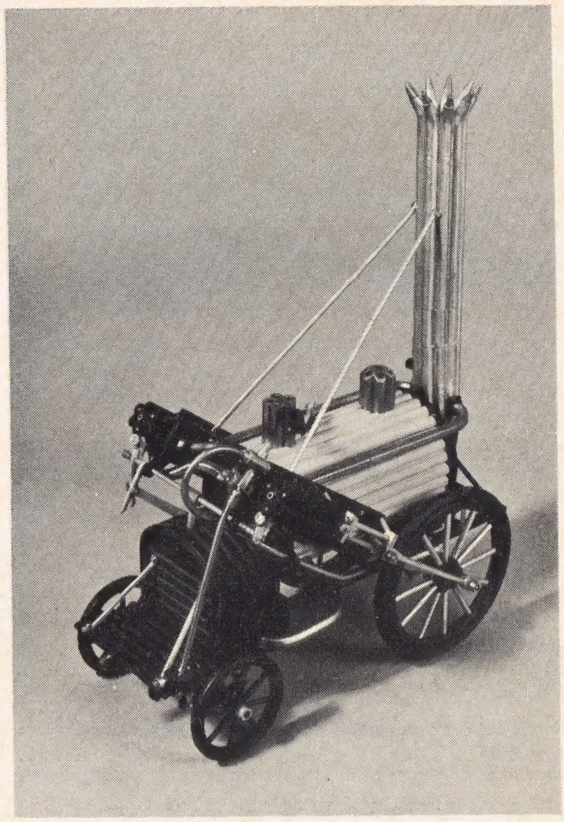
SMOKE RINGS

A Commentary by the Editor

I.M.L.E.C. 1975

By kind permission of the Tyneside Society of Model & Experimental Engineers, the International Model Locomotive Efficiency Competition will once again be held on the Newcastle upon Tyne track, and it will be on Sunday, July 6th.

The rules and regulations have not yet been finalised, but will almost certainly be much as at Bristol last year, although the intention is to keep six places for entrants who have not competed before. Entries can however be accepted as from the date of this issue, and Society entries should be made, with full details of the locomotive, by the Secretary or Chairman of the Club concerned.



The First Prize winner of the Bic Model Making Competition, a "Rocket" by Alan Hardman of Burghfield Common, near Reading.

Open Days at R.H.D.R.

The Romney, Hythe and Dymchurch Railway Association is organising Open Days to be held on the R.H.D.R. on Saturday and Sunday, June 7th and 8th. The main activities will be centred upon New Romney where attractions will include traction engines, organs, railway preservation society stands, and the Railway's own model exhibition. There will also be a miniature passenger-carrying railway.

The engine sheds will be open, although most of the 15 in. gauge locomotives will be in service. On both days, there will be two express trains running 19.3 miles non-stop from Hythe to New Romney via Dungeness. A frequent service of trains, all steam-hauled, will operate over the railway throughout the period, requiring seven locomotives to be in steam.

Direct coach services operate to Hythe from all parts of London; operators include East Kent, Timpsons, Grey-Green, Orange Luxury Coaches, Lewis' and Venture Coaches. For those coming by rail, British Rail "Awayday" tickets will be available at many stations. The fare includes the rail journey to Sandling or Folkestone, East Kent buses between the B.R. station and the R.H.D.R. station and freedom of the R.H.D.R. (except for the special trains) for the day.

Round Britain Record

Five Royal Navy personnel are to attempt to establish a new Round Britain record, raising funds for the Royal National Lifeboat Institution. Using a small commercial craft called the 12 metre Sea Truck, lent by the manufacturers, Rotork Ltd., they plan to complete the 1800 mile circuit in about fifty hours.

Starting and finishing at the Royal Naval College, Greenwich, they propose to make the attempt in early June, when a favourable weather forecast is received.

Swanage Railway Project

I hear that the Dorset County Council has given the go-ahead to the Swanage Railway Society to re-open the line between Wareham

The very fine clock by John Stevens which won a Silver Medal at the M.E. Exhibition.

and Swanage. At present there is an intermediate station at Corfe Castle, and new halts are planned for Worgret, Blue Pool, Harman's Cross and Herston. The Railway Society undertakes to run a schedule service between Swanage and Wareham with a daily frequency on weekdays of not less than four trips in each direction.

"Filtrate" & David Joy

As readers know, the 150th Anniversary of the opening of the Stockton & Darlington Railway is being celebrated this year, and it is interesting to note that the firm of Filtrate Ltd. supplied the lubricating oil for the S & D locomotive *Locomotion No.* 1 and for the *Rocket*, at the Rainhill Trials. The original name of this firm was W & E Joy of Leeds, Seed Crushers and Oil Refiners, established in 1807.

William Joy, the senior partner, brought into the business his two sons, William Glover Joy and Edward Joy, Junior, making them partners in 1844. Edward Joy, Senior, left his brother William and with four of his sons founded Edward Joy & Sons of Leeds. Edward Joy died in 1863 and three of the brothers continued in partnership until 1888, after which George Outhwaite Joy took over the business with the help of his two sons Herbert and George. David Joy, Junior, the eldest son of Edward Joy, was born in 1825, and left the family business early, to be apprenticed to Fenton Murray & Jackson at 18. When only 19, he was largely responsible for the design of the famous locomotive *Jenny Lind* (named after the brilliant Swedish Soprano of the time).

In 1850, David Joy became Superintendent of the Nottingham & Grantham Railway, and afterwards of the Oxford, Worcester & Wolverhampton Railway. In 1857 he patented his Hydraulic Blower and in the same year brought out his Patent Compound Marine Engine, in which the high-pressure piston acted as the distributing valve for the low-pressure cylinder. His Patent Steam Hammer followed in 1860, and the valve gear which bears his name in 1879.

The name *Filtrate* dates from 1901, and *Filtrate* oils were used to lubricate the original Armstrong Siddeley and Wolseley motor cars. They were also specified for the first Morris Oxford to leave Lord Nuffields' (then W. R. Morris) Cowley Works in 1912.

S. Summerscales

A reader has asked us if we have any knowledge of what happened to the patterns and castings formerly supplied by the late Mr. S. Summerscales, who was a regular advertiser in "M.E." before the War. The answer is no, but possibly one of our readers may have some information.

Link valve gear

I was interested to read John Haining's notes on the question of whether a horizontal steam engine with Stephenson link valve gear should be arranged so that the expansion link is in the down position in forward gear, and also Mr. E. H. Jeynes' explanation. But I do not think that Mr. Jeynes' explanation is correct. Provided that the longitudinal centre-line of the motion is truly horizontal, the weight of the eccentric rods and the link itself must be carried by the lifting links whether the link is in the "up" or "down" position. This is confirmed by locomotive practice, where the weight of these parts is either counterbalanced by a weight, or taken care of by a spring, as in G.W.R. designs.

It certainly seems logical to have the expansion link in the "down" position for forward gear, but I think there must be some other explanation as to why the links and pins lasted longer with this arrangement.

The Model "Engineer" Steam Roller

An Aveling & Porter 2 in. scale Compound

Part XII **_Built and described by John Haining_** *From page 271*

Valve Gear

ON READING Part VII (M.E. 3501) of this series again, and looking through my notes on the valve gear, I realise that in my efforts to provide readers with several different "starts" and thus a modicum of variety in their bench work, further notes on the valve gear layout were not included where they should have been. Furthermore, my drawing showing the layout of the valve gear does not depict the eccentrics and rods in their true position relative to the crank.

The full size roller is shown on the official Aveling & Porter drawings as having crossed eccentric rods. These should be shown diagrammatically as in Fig. 1, with the crank on back dead centre and the eccentrics set to lead the crank by 90 deg. *plus* the angle of advance in direction of rotation. As shown in Fig. 1 the crossed rod arrangement has the *top* eccentric joining the *bottom* eye of the link, and the *bottom* eccentric joining the *top* eye of link, thus in back gear, with link down we have the crankshaft running *backwards* to transmit *forward* motion to the road wheels, and the reversing lever *forward* in the quadrant.

If the roller had open eccentric rods, with crank at back dead centre, one rod would join the top eccentric with the top of the expansion link, the other joining the bottom eccentric with the bottom of the expansion link.

When depicting the type of arrangement used in any particular valve motion, the engine crank must be shown placed on back dead centre, as this is the only position in which the open-rods arrangement shows the eccentric rods open, and the crossed-rods arrangement the rods actually crossed. From this it will be seen that, if the engine crank and eccentrics be rotated through 180 deg. so that the crank is on front dead centre, the open rods will appear crossed, and the crossed rods open. (Fig. 2).

With the crossed rod arrangement, lead is at its maximum when the expansion link is in full forward or full backward gear; in Stephenson gear, with outside admission valves and open eccentric rods the lead increases as cut-off is reduced, whereas with crossed rods the lead and cut-off are decreased together.

I was always taught, in my drawing office apprenticeship days, that it was considered bad practice to so design a horizontal steam engine that it ran with links up when performing its main work, whether it be arranged to run in an anti-clock or clockwise rotation, but as the lifting links and pins always carry the weight of the expansion link and eccentric rods the value of this teaching is somewhat doubtful, and may have emanated from a Chief Draughtsman who had his own very firm ideas on a number of design points. Referring to Anthony Beaumont's letter (M.E. 3504) the reversing lever on the Aveling roller is, of course, *forward* to give forward movement of the roller i.e., engine running backwards.

Firehole Door

For a couple of reasons I purposely made the firehole aperture of generous proportions. The larger the firehole can be made, the easier it is to feed coal into the firebox, particularly on a traction engine or roller where the shafts have a nasty habit of getting in the way, and I particularly wanted to try an alternative method of mounting the actual firedoor to avoid attaching the door hinge and catch directly to the backhead.

A firehole of $1\frac{5}{8}$ in. dia. left me with enough space to fit the liner shown in my drawing and still have a firehole of $1\frac{1}{2}$ in. internal diameter.

The liner is made in two parts, an inner ring being welded to the end projecting inside the firebox, with an outer ring fitting tightly over the end outside the backhead.

Insert the liner from inside the firebox so that the inner welded ring fits snugly against the firehole ring—the liner should be as tight a fit as possible inside the firehole ring—and then pin the outer, larger ring to the outside of the liner as close to the backhead as possible.

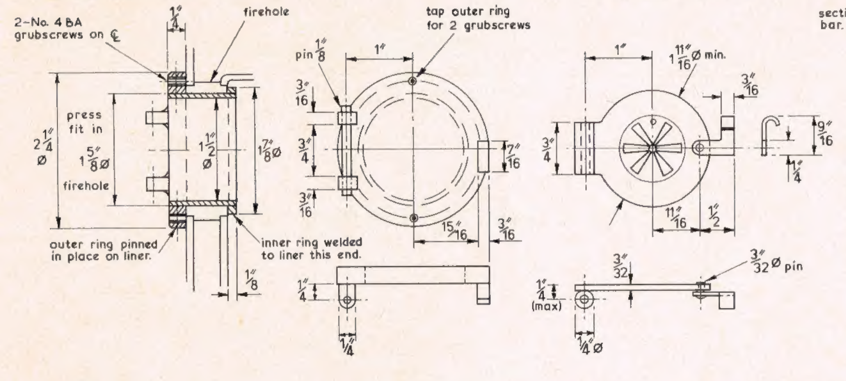
Before fitting the ring in position drill and tap the two 4BA holes which are for a couple of grubscrews to bear against the backhead, ensuring that the inner ring is pulled tightly against the

Fixed Drive Gear.

Near Side Drive Plate

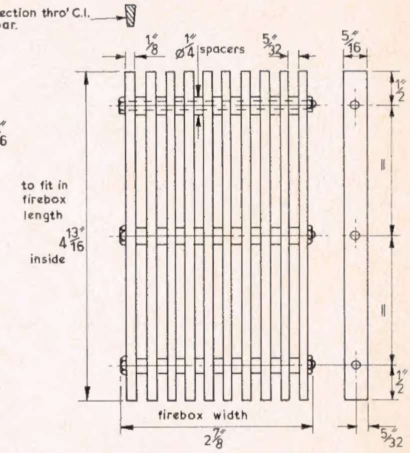
Firehole Door.

Firehole Door



FIREHOLE DOOR (TO FIT ON FIREHOLE LINER)

B.M.S.

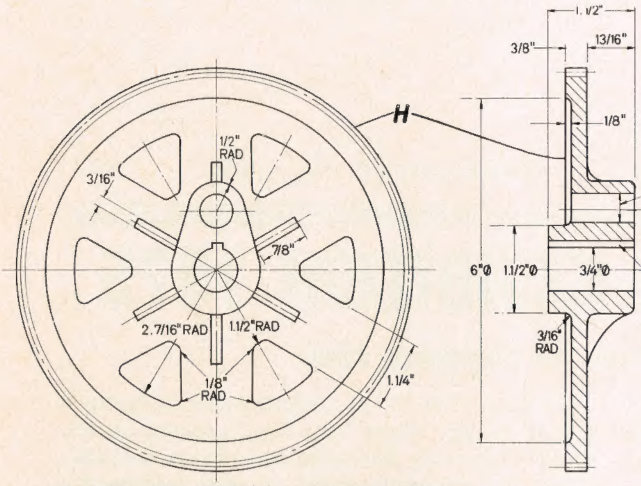


FIREBARS

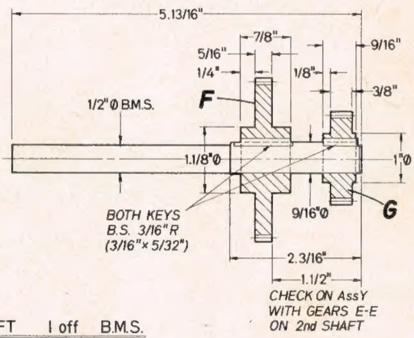
B.M.S. or cast iron

GEAR DETAIL

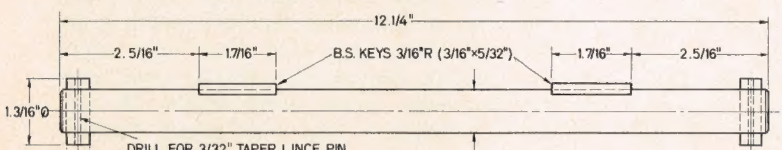
F	—	2·666 P.C.D.	32 TEETH	12 D.P.
G	—	1·500 P.C.D.	12 TEETH	8 D.P.
H	—	6 750 P.C.D.	54 TEETH	8 D.P.



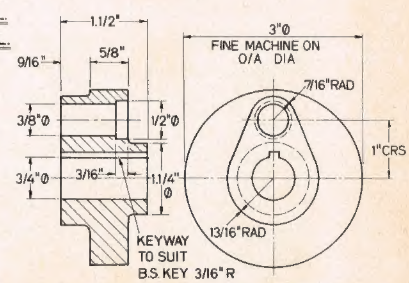
FINAL DRIVE ROAD GEAR 'H' I off CAST IRON



3rd SHAFT	I off	B.M.S.
GEAR 'F'	I off	STEEL.
GEAR 'G'	I off	STEEL.



REAR AXLE I off B.M.S.



NEAR SIDE DRIVE PLATE – BRAKE BOSS

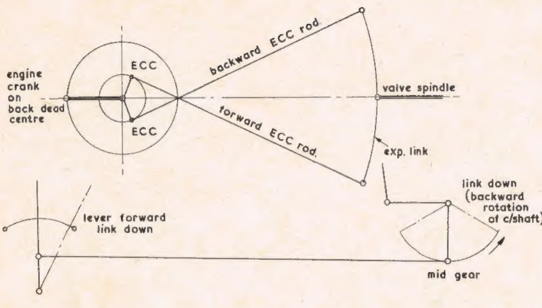
I off CAST IRON

inside of the firehole ring, when assembled.

The outer ring carries the two hinge blocks upon which the door swings and on the opposite side the catch for the pivoted latch mounted on the door itself.

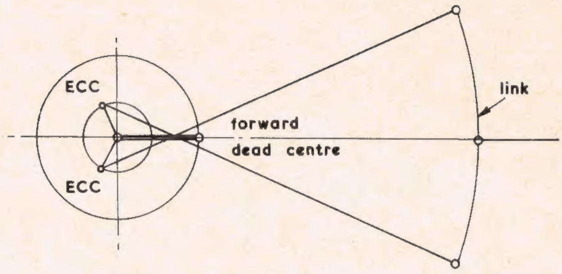
The firehole door on the full size roller has central air vents with six apertures covered or uncovered by a circular cover moved by a small hand-knob; I have indicated this on my drawing, but have not in fact included the detail on the two-inch scale boiler.

One of the advantages of this type of firehole door mounting is that the sleeve may, if desired, be extended back below the third shaft to make firing easier.

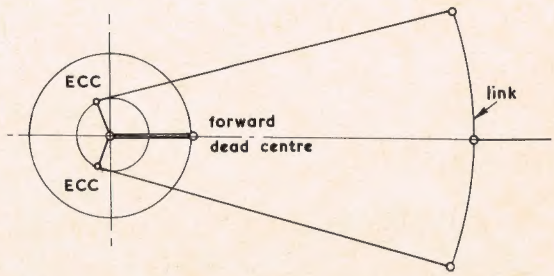


STEPHENSON GEAR CROSSED ECCENTRIC RODS (diagrammatic)

Fig. 1



OPEN ECCENTRIC RODS — CROSSED



CROSSED ECCENTRIC RODS — OPEN

Fig. 2

ERRATA

Page 165, Feb. 21st. — The equi-spacing of the rear roll spokes should be 51° 25 min. 42 secs.

Page 166 — Tenth line should read: — "of the third shaft, H being the large gear with . . ."

MODEL ENGINEER EXHIBITION 1975

Further reports from the Seymour Hall

The Club Stands

from page 332

IN THE OPPOSITE CORNER of the workshop, first Arnold Throp and then George Thomas, ran through various operations on the Super 7 lathe. George arrived with several boxes of tools, gadgets etc., and spent long hours happily talking to his audience about them. It was interesting to observe him in action; someone watching George would make a comment or put a question. He would dip into a box, produce some tool, hold it up, a poke, a prod, a twist, a turn, and all the while a steady flow of explanation and description. A nod or two from the visitor and there was another satisfied customer!

The Display Stand

This year the stand was about twice as big as in a normal year. My notebook has 28 items listed as being on the stand and some of these I have noted as groups of items. The largest exhibit was a 2 ft. by 4 ft. case of patterns and core boxes for R. C. Stephenson's compound marine engine. "Steve" has been working on the engine for a very long time and was at last able to put the completed model on show underneath the case of patterns. The engine has $1\frac{3}{4}$ in. h.p., 3 in. l.p. bore by 2 in. stroke cylinders and it is an excellent job. One large hind wheel and other parts of the 3 in. Burrell T.E., already mentioned in the Workshop report, were shown. W. H. Clarke is building a 1 in. scale Sharp Stewart 2-4-0 locomotive, circa 1850, and he put the boiler, frames and smoke-box on the stand. "Nobby" has a problem of getting decent valve events out of the old fashioned short travel arrangement of Stephenson gear on the prototype, there being little space under the boiler for modern long travel links. He is, as he says, working on it. For some time George Thomas has been bringing to our meetings parts of his $\frac{3}{4}$ in. scale LNER "Pacific" for our delight. We have previously had the engine chassis on the stand and this year the tender chassis was shown, upside down so that the fine detail could be seen.

There were plenty of other models around to suit all interests; several steam engines, locomotives, traction engines, a coal wagon, feed pump, Congreve clock — an ingenious and fascinating piece of work, petrol engines, etc etc. F. R. Lowne who showed his $\frac{3}{4}$ in. scale LNER B2 4-6-0, had an ancestor who invented an atmospheric (vacuum) engine. To show that the idea would work, the inventor made a model engine and Mr. Lowne put this very old model on the stand. Probably the most interesting model for any petrol engine enthusiast was a 3 in. scale model of a 9 cylinder Gnome rotary aero engine by N. S. Hemingway. It was shown partially dismantled and was worth very close inspection.

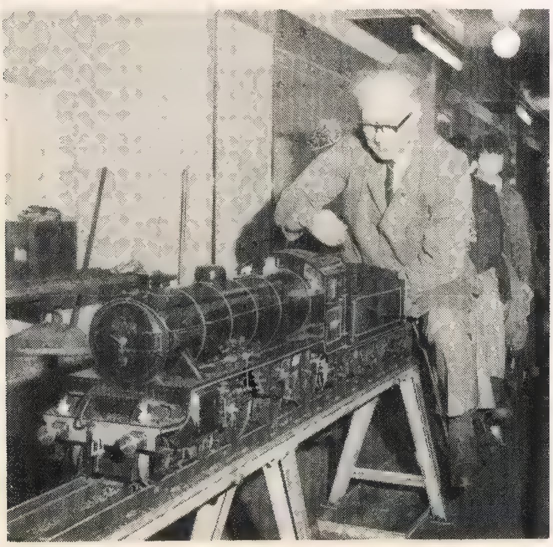
L.B.S.C. Competition

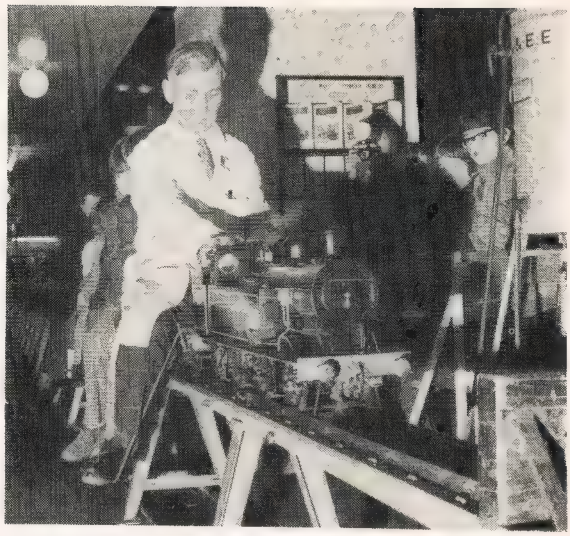
by J. Ewins

I FEEL THAT 1975 will not be remembered as a good year for locomotive entries at the Model Engineer Exhibition. This was certainly so with the entries for the L.B.S.C. competition. Of the eight originally listed, only four were presented which was rather disappointing compared with last year's record number.

The locomotive gaining the award was Mr. J. A. Elliott's *Princess Marina,* which was a particularly pleasing example of one of L.B.S.C.'s more successful designs. It was turned out in black livery with B.R. style lining which was reasonably well done. The track performance of this engine was not without its problems which were mainly associated with boiler feed. An injector was fitted but hardly worked at all and the hand pump which had to be used appeared to suffer from ball-valve bounce. At times it was difficult to keep the water level up. We judges got the impression that the engine tended to be a shy steamer on light loads which is not necessarily a criticism if it is normally used on heavy loads. We also noticed that the exhaust was rather wet which seems to confirm that at least for light loads a smaller blast nozzle would be an improvement. The model was nicely presented on a plinth with Perspex cover and we congratulate Mr. Elliott in winning the Bowl.

Bertie Green driving his 5 in. gauge "Mayflower" on the S.M.E.E. track.





Jim Ewins driving his 5 in. gauge 0-6-2T.

The runner-up was a *Tich,* made by Mr. W. D. Smith of Colchester. This was the engine which surprised us most. The engine was unpainted but very well finished, Mr. Smith having adhered closely to the published design and thereby produced a pleasing little machine which must have given him a great deal of pleasure in building. It was clear when the engine was steamed that Mr. Smith was new to the technique of handling tiny steam locomotives, so Laurie and I took the matter in hand. We were both delighted by the performance put up by the little engine and apart from a few minor items, found little to find fault with. One trouble which showed up as soon as steam was raised involved the "buzzing" of the safety valve which resulted in the unwinding of its adjustment and this very nearly prevented a run at all. This entry, although not such an ambitious model as the *Marina,* almost made up for this in its track performance to the extent that according to our marking scheme there was

The winner of the L.B.S.C. Memorial Competition:— The 3½ in. gauge 2-6-0 "Princess Marina" by J. A. Elliott.

only a mark or two between the two entries. Had the *Tich* been nicely painted with perhaps a more reliable safety valve, it may well have won the award. Hard luck, Mr. Smith! Although with such a small entry a second prize would not normally be awarded, we judges felt that on this occasion the contest had been so close that Mr. Smith's work should be very highly commended. A small token was presented to him in recognition of this.

The two other entries unfortunately did not perform very satisfactorily although the *Tich* made by Mr. D. E. Bowerman appeared to be nicely made and very well finished in yellow and black livery. The entry made by Mr. F. C. Matthews was a *Juliet* design having a Bremme valve gear and although this aspect of the engine seemed to be quite satisfactory, Mr. Matthews had difficulty in keeping steam.

The Ship Models

by Martin Evans

ENTRIES OF Ship models were again very good, both in quantity and quality. Tugs and warships seem the most popular prototypes, and among the former, the *Campaigner,* by K. F. Clover of Bushey Health, was outstanding. This was a large (about 55 in.) model of an ocean-going tug, and it was notable for all-round excellence of workmanship and the good finish of the hull, which was of glass-fibre. The power plant was displayed separately, and consisted of a Stuart double-ten engine and a paraffin fired centre-flue boiler. This model was awarded the Championship Cup and the Edgar Westbury Memorial Challenge Trophy.

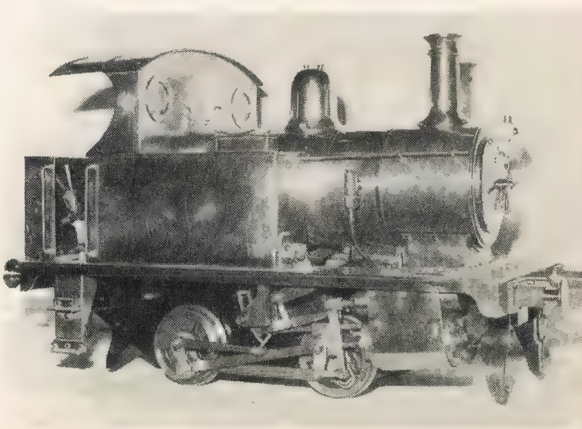
W. Nunn of Battersea carried off a Silver Medal and the Exide & Drydex Cup for a fine destroyer, H.M.S. *Caesar*. The hull of this model was made to represent steel plating, and the deck fittings were both comprehensive and accurate.

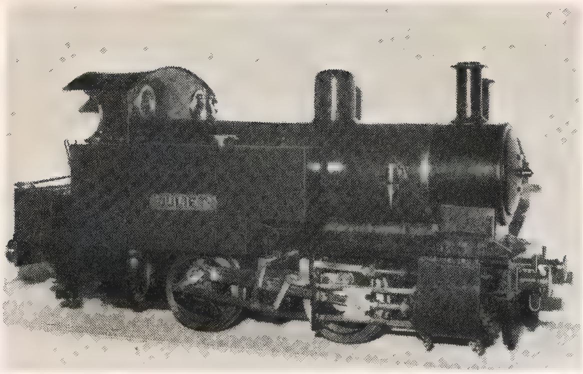
A waterline model destroyer in a glass case, H.M.S. *Cossack* by E. R. Dyke of Wivenhoe, was a fine piece of work with a most realistic finish. This ship was illustrated on page 123 of our February 7th issue. This model was awarded a Silver Medal.

An unusual ship model was a New York Harbour fireboat *Fire Fighter* built by R. M. Watts of Finchley. The lattice work tower could be raised and lowered by radio, while lights, steering and ahead and astern control were by radio. V.H.C.

A British 18 gun Man-of-War by L. S. Danilewicz attracted a lot of attention with its unpainted woodwork and bright brasswork. The excellent

The runner-up was this "Tich" by W. D. Smith.





3½ in. gauge "Juliet" by F. C. Matthews.

workmanship gained this model the Championship Cup in Class F.

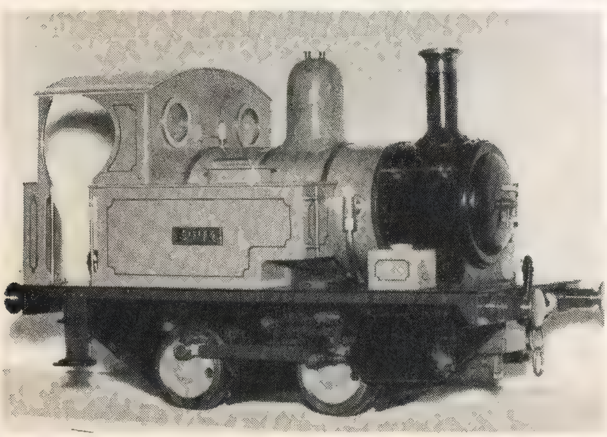
Once again, the miniature ships were to a high standard, with Aylesbury's D. Hunnisett well to the fore with two entries — a model of the *Golden Hind* and of *La Superbe*, a French 74 gun warship of 1785. Both these were of impeccable workmanship, the latter taking the Championship Cup, and the former a Silver Medal. K. Stuttard of Birkenhead showed a model of H.M.S. *Grasshopper*, an 18 gun Brig. This was awarded a V.H.C. Certificate, while E. P. Heriz-Smith gained a Commended certificate for a Roman merchant ship.

Trade Stands

Myford Ltd. of Beeston, Nottingham, have been known for their excellent small lathes for nearly forty years. On the Company's large stand were to be seen the latest Super 7 lathe, now fitted with automatic cross-slide, the M.L.7 with the Tri-leva quick change device, the new M.L.10 3 in. centre lathe and the M.L.8 wood-turning lathe. Accessories to be seen included the Rodney vertical milling attachment, lever-operated collet equipment for the lathes, forming and parting-off slides, and six-station turrets.

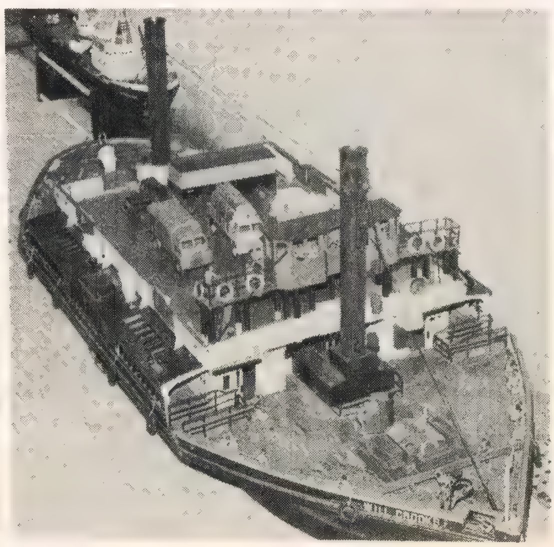
N. Mole & Co. (Machine Tools) Ltd., showed a fine selection of machine and hand tools,

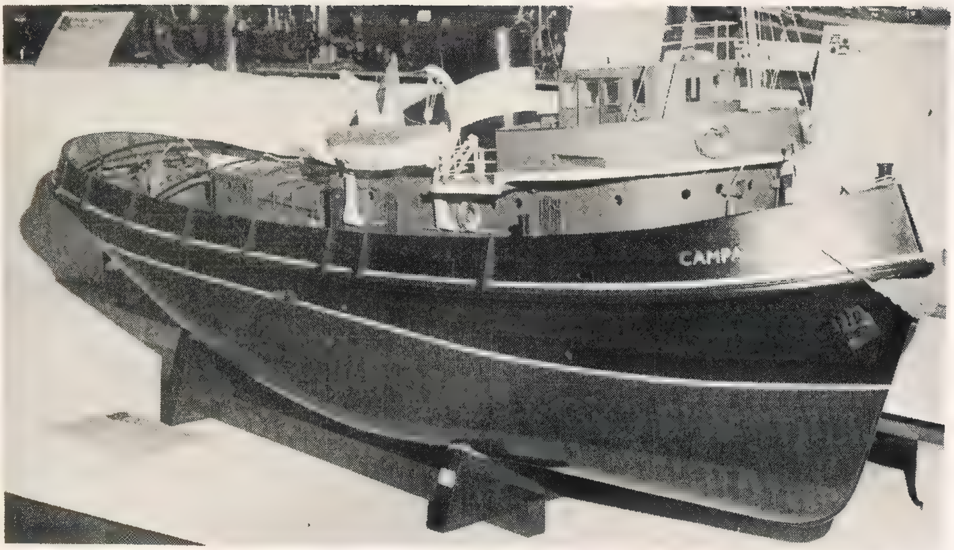
3½ in. gauge "Tich" by D. E. Bowerman.



D. Hunnisett's Championship Cup winner, "Le Superbe".

Woolwich Ferry Boat by P. Jenkins.





The Championship Cup in Class E went to K. F. Clover for this fine ocean-going tug.

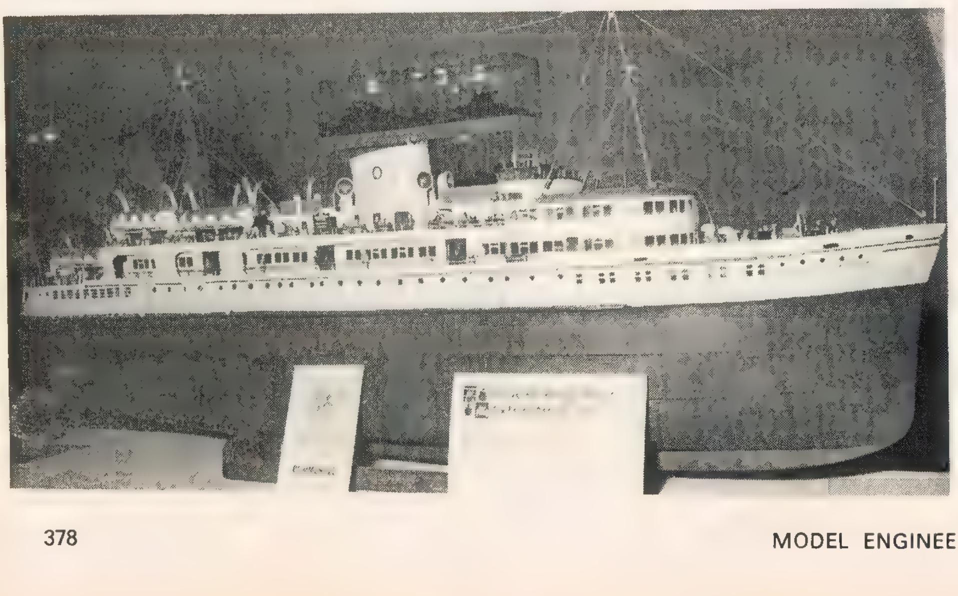
including Myford, Boxford and Denford lathes and a new ½ in. capacity drilling machine of their own manufacture. This is fitted with a ¼ h.p. single-phase motor giving four speeds from 570 to 3500 r.p.m. and has a table 8 in. x 8 in.

Kennion Bros. of Railway Place, Hertford, showed a wide range of castings and materials of all kinds, principally for the builder of live steam locomotives from Gauge "0" to 7¼ in. Several well-finished locomotive parts, such as mechanical lubricators, pumps, etc., were on display, also a range of small tools.

Traction Engine Enterprises, now at Hinckley, Leics., showed records and books on model engineering, traction engines, fairgrounds and similar subjects. A large range of colour slides and framed prints was also to be seen, not to mention the back numbers of Model Engineer, including bound volumes and indexes, for which this firm is well known.

Morris & Ingram (London) Ltd., showed the full range of the well-known Badger Airbrush equipment, which has brought spray finishing within the reach of everyone's pocket. The Hornet portable mains-electric air compressor could be examined on this stand.

Beatties of London had a comprehensive display of Triang-Hornby, Hornby-Minitrix, Fleischmann, Wills kits, Z gauge by Marklin, Preiser figures, Faller "OO" and "N" model kits and model boat kits by Airfix, Billing, Revell, etc.



M.V. "Royal Sovereign" by A. Waller of North Watford.

Building a Horizontal Engine

By "Tubal Cain"

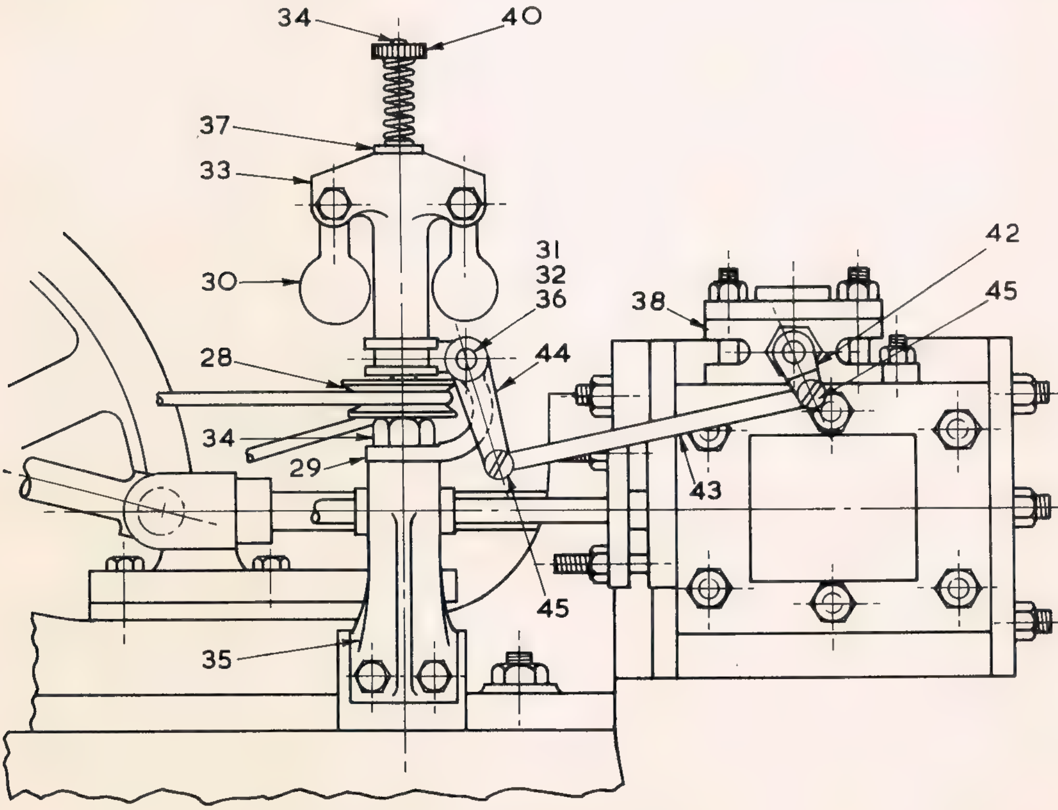
Part VIII *From page 343*

ENTER THE PISTON to the counter-bore and gently press downwards; the ring should enter the bore without too much pressure. If it is stubborn, wrap a piece of .005 in. shim brass round the rings and tie a piece of string round to compress the rings. They should then slide out of the brass cylinder into the bore quite sweetly. Don't fit the back cover yet.

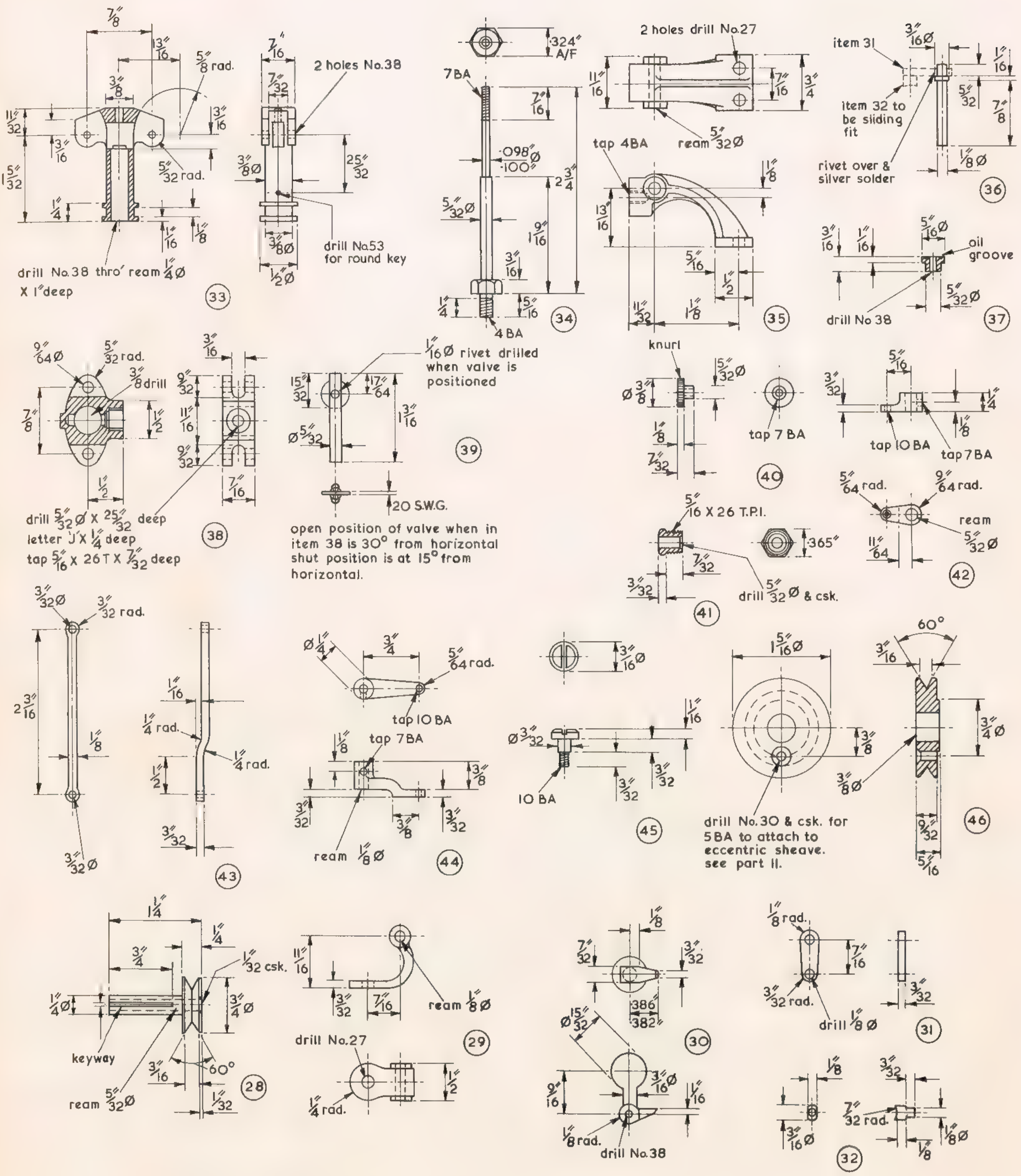
Bolt the cylinder to the frame — you will have to "wangle" the crosshead through the hole — putting a trace of oil on the paper joint, and checking that the crosshead slides freely. Fit the slide bars, and then the connecting rod end. Now cautiously rotate the crank and see that all is free. Attach the steam chest with its joint, and slide the valve rod through the guide gland and "O" ring. Take care not to damage the latter on the threads, and don't forget to put the valve in place right way round. (You may have to remove the eccentric, if still on the shaft, to get the rod through). Align the eccentric and connect to the valve-rod, the latter being screwed through the valve nut enough to ensure that the valve doesn't come hard up against the ends of the steam-chest.

Put a couple of temporary nuts and a pack of washers on to hold the chest in place. Fit the flywheel, having made a key for it, but don't drive the latter right in at this stage. Oil all the bearings.

To set the valve, rotate the eccentric and adjust the position of the valve on the rod until the opening of the ports at each end of the stroke is the same. Test this with feelers, but of course you can only adjust to half-a-pitch on the thread of the nut. Get the best compromise you can.



ARRANGEMENT OF GOVERNOR


2 holes No.38
drill No.38 thro' ream 1/4 Ø X 1" deep
drill No.53 for round key
7BA
.324" A/F
·098" Ø ·100"
4 BA
2 holes drill No.27
ream 5/32 Ø
tap 4BA
item 31
item 32 to be sliding fit
rivet over & silver solder
oil groove
drill No 38
knurl
tap 7 BA
tap 10 BA
tap 7BA
1/16 Ø rivet drilled when valve is positioned
20 S.W.G.
open position of valve when in item 38 is 30° from horizontal shut position is at 15° from horizontal.
drill 5/32 Ø X 25/32 deep
letter 'J' X 1/4 deep
tap 5/16 X 26 T X 7/32 deep
5/16 X 26 T.P.I.
·365"
drill 5/32 Ø & csk.
tap 10 BA
tap 7BA
ream 1/8 Ø
10 BA
drill No.30 & csk. for 5BA to attach to eccentric sheave. see part II.
60°
keyway
ream 5/32 Ø
1/32 csk.
drill No.27
ream 1/8 Ø
·386 ·382
drill No.38
drill 1/8 Ø
33
34
35
36
37
38
39
40
41
42
43
44
45
46
28
29
30
31
32

The eccentric must now be rotated on the shaft till the lead — the opening to steam when the crank is on the dead centres — is the same at each dead centre. How much lead you allow is a matter of argument, but at this stage a two-thou feeler should go in. Don't forget to push the valve against the face, and against the direction of motion to take up the backlash, also — most important! — get the direction of rotation of the crank right, which is crank going *away* from cylinder when the rod is *above* the centreline. This setting will do for a start, and you can now lock up the eccentric and attach the steam-chest cover and the temporary steam connection. Fit the back cover and its joint as well. I never use jointing compound on these covers — I use "Oakenstrong" jointing, but thick brown paper will often do — but do soak it in cylinder oil.

You can, if you wish, give the engine a run on the lathe to bed in the rings a little, but it isn't essential. Before doing so, or applying air pressure, check that all nuts are tight and that there are no tight spots indicating that something is fouling. (It occasionally happens that the cavity in the valve-chest hasn't been cleaned out enough, and the valve fouls the end). Connect up compressed air, or a tyre foot-pump, and the engine should rotate; if it needs as much as 40 lbs. to move it, something is wrong (if there is a loud hiss, fit the drain cocks!) the most likely cause being that the eccentric set screw has not, in fact, tightened onto the shaft and the timing slipped. However, seek out the cause and remedy it. You should find the engine rotates happily enough on 15 to 20 p.s.i., the required pressure dropping as all beds in. Once the pressure is down below 12 p.s.i., you may find the engine running jerkily. This is due to the fact that at the low pressure the expansion after cut-off is bringing the cylinder pressure below atmospheric, at a point in the stroke where the other side of the piston is compressing its contents after the closure of the exhaust port. Don't try to correct this by altering the timing; give the engine a little work to do instead — a well oiled piece of wood, hinged so that it presses on the top of the flywheel, with a spring to apply a load, for example.

After half-an-hour it pays to remove the cylinder and chest covers, and see that the bore and the port-face are bedding in nicely. You should, of course, have washed all parts before you started and removed all traces of dirt. You can try adjusting the eccentric and the valve position a trifle either way, but don't forget that if you alter the valve position, you must also adjust the eccentric as well, though you can alter the eccentric alone if you wish. Very slight movements have quite a marked effect, and you should select that which gives the most even beat on a moderate load on the engine. If you suspect that the valve position on the rod is not quite right, and you can't adjust it for the reason mentioned earlier, then try the effect of a light skim off the face of the forked end of the rod (item 9) just enough to bring the rod forward a quarter turn. This will enable you to get a setting midway between the two you have already tried.

After a few hours you should strip down, clean out everything, (for the running in process must inevitably leave metallic particles in the works) re-oil, and put together again, ready for fitting the governor.

Governor pulley (Part 28)

Chuck in the 4-jaw by the pulley, set true, and centre the end. Support this end in the tailstock, and rough down the O.D. to about 20 thou oversize and face the end. Set this diameter in the 3-jaw and similarly rough out the pulley, but leave rather less on here. Drill and ream 5/32 in. Face the pulley end. Remove from the chuck, and drill a 1/16 in. hole about ⅛ in. deep and positioned so that it will not break into the vee of the pulley. Push in a ¼ in. long piece of steel. Now make a stub mandrel about 5/32 in. long, with a shoulder as near the chuck jaws as you dare. Push the sleeve onto this, the little peg aforesaid between two of the chuck jaws (saw a slot in the shoulder of the mandrel if need be) and bring up the tailstock at full extension to engage with the end of the bore. Finish the O.D. to micrometer dimensions, 0.250in. Finish machine the pulley. You can either mill the keyway with a tiny endmill, or "plane" it as you did the keyway in the flywheel. The depth of the keyway should be not more than 1/32 in. Remove the burrs — the exterior of the sleeve must be quite parallel and a good finish.

If, on examination, the piston shows signs of having hard pressure or wear over *part* of the circumference, remove the rings and ease the worn patch, and about ⅛ in. either side, with a fine oilstone. Wash out well before replacing the rings.

Governor weights (Part 30)

Chuck truly by the head in the 4-jaw and set the outer end true. Centre with the Slocombe, and support this end in the tailstock. Rough out the body, say +.015 in., and face the end to 1-5/32 in. from where the centres of the lugs *will* be, if you follow me! Machine the groove, again leaving a bit on, and the underside of the lugs. Drill just under ¼ in. and bore (not ream) the ¼ in. hole, going a trifle deeper than the 1 in.

shown. Bore this to a nice running fit on the pulley or sleeve, part 28. Now comes the tricky bit. The No. 38 hole at the top must be concentric with the bore. If you have a Slocombe long enough to reach down the bore, and ¼in. dia., you can use that to restart the drill. If not, then you must make a flat drill, the point being about 3/32 in. dia., out of ¼ in. silver steel, and use this up the ¼in. bore to truly start the hole. This done, drill through No. 38. Lightly countersink the end of the bore.

Make a stub mandrel and mount the work on this — it needs to be a tight fit. Face the end — and machine the profile of the weight carrier end. Polish the top. (The set-over for this angle is about 21 deg.). Finish turn the body and the groove, and polish the latter; the ⅛ in. wide groove should be just to size, and polished also. Set the lugs horizontal in the machine and mark out the width of the slot and the 7/16 in. outside width. You may mill or file these lugs to choice, but the 7/32 in. slots must be true and opposite each other; if you use a 7/32 in. endmill you may find the sideways deflection of such a small cutter will give an error here. Better to use a side-and-face cutter as suggested on the drawing or, failing this, a 3/16 in. endmill and finish by filing.

Mark out for the two No. 38 holes, taking more than usual care to see that these are at 7/16 in. from the centre of the workpiece. Strike the radius for the shape of the lugs, drill, and file to shape. Drill for the little key and, when you press it in, drop a piece of 7/32 in. stuff down the bore to prevent it from going in too far; check that it slides on the mating part (28) freely, and ease it if it doesn't. Trim off the rest of the outline, remove burrs, and polish as desired. The rectangular slot across between the lugs may need adjusting later — for the moment just clean it up. This must clear the toes on the weights, part 30. Assemble parts 28 and 33 onto the spindle 34, and see that all spin freely, easing if need be.

Governor body (Part 33)

These come as a pair cast in one, balls outwards, with chucking pieces, and are in a soft malleable iron. Frankly, they are a real problem. Even if you have a spherical turning fixture, the chucking pieces are in the way, and a form tool is not much better. The material is susceptible to hand turning, and that is the way I did mine, but was not satisfied with the results, so I took an alternative path which I will mention in a moment. It is important not only that the balls look right, but also that they be right, otherwise, if one is larger than the other, this one will do all the work. However, let us get on with it. Being malleable iron, the pair can be bent a little if the axis is not true, and this should be done. Chuck in the 4-jaw by one of the pieces, and true up the projecting chucking piece and centre it. Take this in the 3-jaw now, bend till the second chucking piece is nearly true, machine that one, and centre. Support in the tailstock. Turn the balls to about ten thou over 15/32 in. and note the cross-slide index reading. Measure the "ball" diameter, and calculate the movement necessary to turn the points of the "toes" to .390 radius (.780 dia.) — this allows for a trimming operation later, but ensures they are both the same. Don't bother about the profile, machine them straight across. Now measure from the edge of the notch in the casting towards each ball a distance of 11/16 in. plus 1/64 in., and make a tiny groove round — this marks where the centre of the ball is to be. Don't go in more than 2 or 3 thou. Measure back to the centre of the casting from these grooves an accurate ½ in. and machine the flat faces of the toes. Retract away from the face 1/16 in. to allow for the boss round the hole and machine the stems to 3/16 in. as far as you can without cutting into the "ball". Then, with a parting tool, measuring from the mark made on the ball centre, trim these to 15/64 in. plus a few thou either side of the mark. This leaves you with more or less a cylinder, central to the desired centre of the ball, nearly correct in diameter and length.

Machine the stem up to the shoulder so formed (on each ball) blending with a small radius. If there is any of the cast surface left, skim this off by manipulating top and cross-slides with a round-nose tool. Set up your handrest, and with a tool like a flat scraper, but better somewhat rounded across the face, zero top rake, 10 deg. clearance, and razor honed, form the shape of the balls — go from one to the other, keeping them alike as far as you can. Work from the large diameter to the small, always. Check from time to time for sphericity and if need be make a template. Don't hurry the job, and with care you will get both true, both alike, and only the chucking pieces to be taken off later. You can try a tool if you like, but will have to be careful to avoid chatter. (Oh, cutting speed for this hand turning, with carbon steel tool, about 200 rpm).

Take out of the machine and file or mill the 7/32in. width of the toes, and then mark out for the No. 38 holes — best done between centres in the lathe. Centrepop, and scribe the circle for the ⅛ in. radius. The longitudinal position of these holes is, of course, taken at 1/16 in. from the face of the toe. Mark out for the profile of the

toe as well. Now, using packing as required, grip by the centre and set one ball running true, and part off the chucking piece, after which you can hand-turn or form the end of the ball. Reverse, reset, and repeat. Polish each ball as you finish the turning. Drill the hole No. 39, and check the fit on the bolt supplied. Open out No. 38 if need be. Saw in two, file the boss and the lever to shape, but leave the toe still over size. Fit each for width to the slot in the carrier (Part 33) and mark them. Now assemble part 33 and balls to part 28, and attempt to insert the spindle 34. You must file the point of the toe, a little at a time, till it JUST clears the .100in. dia. of 34 in all positions. At the same time, the toe must bear on the .100 in./5/32 in. shoulder without slipping off. (Except, perhaps, when swung right out). Wedge the balls a small equal distance away from the stem of 33, and see that both toes are bearing at once on this shoulder — if not very carefully adjust one of them till they do. Trim off all burrs, and there you are!

The alternative is to use commercially available bronze or steel balls. The procedure is more or less the same as above, except that you machine the balls down to 3/16in. diameter, leaving the chucking pieces though. Carry on to the point where you would saw in two, but don't. At this stage, machine the stems as shown in fig. 24, between centres still, then cut off the chucking pieces, saw in two and cut the 6 BA thread. Chuck the ball in the 3-jaw, and drill and tap as shown. The ball is then screwed onto the stem with a little Loctite after finishing the profile of the toe and so on. My second attempt was made this way; the hand turned balls measured up to within .002 in. of each other, but could clearly be seen to be different — one was plum-pear shaped — measured to dimension but was not round. In fact, I used 7/16 in. balls as I had them by me, and the engine governs, but 15/32 in. balls are soon to replace them.

Governor details

The majority of the rest of the parts on the drawing are either simple turning jobs — if perhaps a bit tiny — or cases of filing stock to shape. I made the lever, part 44, by brazing the lever to the boss, and used a taper pin to attach No. 42 to 39 instead of a setscrew. The bracket, part 29, after filing up and making the holes, will have to be bent this way or that a trifle to ensure that the lug, part 32, engages properly with the slot in the sleeve, No. 33. Parts which may need some notes are as follows. Offer the pulley to the eccentric on a mandrel, and drill and tap for the fixing screws.

Throttle body, Part 38

Dress off and mark out. Note that the important part of this component is that the cross-hole for the spindle must lie on the centreline of the steam passage, or the throttle valve will lie offset. Set up in the 4-jaw, with the gland boss true, face the end and trim the outside of the boss. Drill as shown, noting that when following up with letter J, the material will tend to drag the drill in if the cutting rake at the point is not reduced. Guide the tap with the tailstock chuck, and cut 5 threads deep. Reset in the chuck at right angles to drill and face the ends. Poke a piece of 5/32 in. stuff through the gland, and use this to set the work true to the existing hole. Face, drill letter U and ream $\frac{3}{8}$ in. (Yes, I know the drawing says "drill" but you want a good fit to the throttle). Mark out for the fixing holes. Put on a $\frac{3}{8}$ in. stub mandrel to face the other side. Trim to the oval and file or mill the cavities in the sides. Drill the fixing holes (use a vice or clamp the work).

Throttle valve, Part 39

Note that the little disc is NOT round, and is bevelled, having been stamped out to fit the hole at an angle of 15 deg., so it has to go in right way round. Establish the shorter diameter and scribe a line across. With a Swiss file, ease this till it just slips into the $\frac{3}{8}$ in. hole in the body. The spindle must be slit accurately on its centreline, and the best way is to set up in the machine vice on the vertical-slide and use a slitting saw of the correct thickness. Remove burrs, and check the spindle in the hole with the valve in place—adjust as required to get an easy movement and no jamming in the shut position. Look at the arrangement drawing—the governor **shuts** the valve by moving the link to the LEFT when the balls rise. Get it right way round in the housing! When satisfied, move the valve to the closed position, and very lightly centre-punch the spindle at the centreline of the passage. Remove, and with a piece of packing in the slit, drill half way through. Replace all (remove the burr) and drill right through, with the spindle not quite butting against the bottom of its hole. Poke a piece of 1/16 in. wire through the hole, ends bent over, which will hold it till final tests show all is O.K., after which the wire can be removed and the rivet fitted and clenched.

Setting up the Governor

See general arrangement of governor. Note that the arch-enemy of all governors is friction. This will cause sluggish operation, a wide difference between the engine speed at full and no load, and hunting when the load is suddenly changed.

All parts must work freely, but the second enemy is slackness or backlash. So, if any part is found to be faulty in this section, make a new one, as (apart, perhaps, from bushing a slack hole) there is no alternative.

Erect the governor on its pillar, noting that the thrust collar, part 37, fits under the spring with the spigot inside it. Pack the gland of the throttle with well oiled yarn; put in a ring of yarn at a time, tighten down on it, remove the nut, put in another ring, and so on, till the gland runs in about 3/32 in., finger tight (assuming the threads to be easy) and the spindle turns freely. It will leak a little at first, but friction here must be avoided at all costs. An "O" ring might be useful here. Fit the two levers 42 and 44, the setscrews very lightly gripping. There must be a small side clearance between the 44 and 46 assembly, and the bracket 29, but only enough to ensure freedom when working. The rod No. 43 may have to have the bend adjusted to line up with the levers. Set the throttle lever so that it is vertical when the valve is closed—the G.A. shows it open. Tighten its setscrew a bit more. Raise the balls and slip a piece of 3/32 in. stuff—a trifle over rather than under—between the sleeve and the pulley, and hold the throttle closed. Tighten the setscrew on the lever 44. This should ensure that the throttle is 30 deg. open (which is full open, the ⅛ in. dia. passage being far larger than the steampipe) before the balls hang down vertically, and closed before they lose control by flying out too far. This setting will serve for trial, and can be adjusted later if need be. The spring will give quite a wide speed control.

Testing

Each engine will be different, as there will be small differences in ball weight, link length, and so on. Further, as you will see from the photographs, my own engine was modified so that the final drive was through a bevel pair, not by crossed belt. This will, in fact, make no difference, as the speed ratio is the same as the belt drive. However, I can only record the effects I obtained, and you mustn't assume that these are necessarily "right". The drive cord was made from a piece of thin braided nylon cord, similar to that used on ceiling pull-switches, welded at the joint with a match flame—though initial tests were made with a piece of string with a knot in it! I believe Messrs. Stuart Turner can supply a steel spring cord for this drive, and I have also been told that the square rubber drive bands used in "Meccano" sets is quite effective, but have tried neither. The effects of belt slip, by the way, are that if the load changes, the governor doesn't immediately follow the speed change, and then over-reacts—a violent form of hunting or "snapping".

With no load on the engine, the speed is found gradually to rise as the air pressure is increased to about 20 p.s.i. Thereafter, increasing pressure makes little difference in speed till 60 p.s.i. when the air hose blows off the inlet connection! The speed can be adjusted down by about 10 per cent and up by a little more by adjusting the spring. Application of load at 40 p.s.i. causes the governor to open the throttle to suit but so far the engine has not been fully loaded. If the load is removed gradually the governor keeps control but sudden removal results in "snapping"—probably belt slip. Sudden *application* of load has far less drastic effects. These tests were made just as the governor was when first erected—no adjustments had been made; the belt is grubby and oily—it was only a "temporary" one (!)—and the gland is known to be a bit tight. I believe that with care in the fitting—perhaps more care than I took—and careful adjustment this governor could be brought to pretty good limits of performance. It is a fiddly thing to make, true, but certainly worthwhile.

Other engine details

The box-bed, supplied as standard, is a simple job. The underside can be filed and then the bed clamped to the faceplate and machined in the usual way—it should clear the gap of most 3½ in. lathes. The only point I would suggest is that the top be drawfiled afterwards—circular turning marks would look a little out of place.

Steam and exhaust flanges—I must confess that the chief problem I have with these is to get a presentable oval shape! The S.T. drawings suggest that the flanges should be screwed to the pipes, but I usually solder the exhaust and braze the inlet flange. I have a second steam flange made up from sheet brass brazed to a union for temporary connections to most of my models. In passing, it is worth saying a word about steam flanges generally. Many modellers like to make their models look more true to prototype, increasing, for example, the number of studs in cylinder covers and so on. Two-bolt oval flanges are not used in general engineering practice very often, and only when they are enforced by lack of space. In this engine, the design of the governor throttle valve would have to be altered a lot to get a circular flange in. However, the point is that IF a circular flange is to be used, it should have the correct number of bolts; that is, 4, 8, 12, 16, 20, etc., ALWAYS in multiples of four, never six. The reason for this is that standard valves, pipe bends, etc., may have to be turned through 90° to suit installation requirements. You can do this with any of the British Standard Flanges, but

not if they have 6 bolts, 18 and so on. (You can with 12 and 24, and these are to BSS). There is the further point that some valve makers supply valves that suit two neighbouring classification tables, one of which might have four bolts for a 4 in. pipe and the other 8. An 8-hole valve can be used on either.

Cylinder lagging and cleading. Some time ago I obtained some material from a friendly sheet metal worker known as "template paper"—a fairly thick, strong, and oil-proof sort of paper, which can be cut easily, and bent round without cracking or kinking. It is well worth while scrounging some if you can. This can be fitted to the cylinder, the holes cut for the exhaust connections, drain cocks, and so on, and then used to prepare the planished steel. I also have a small punch set—a "Witney"—which is admirable for punching clean holes. The steel cuts easily enough if the shears are sharp, but is not so easy to drill, and before I got my punches I used to drill a ring of very small holes and file out with a needle file for cylinder lagging. Drill or punch the holes at one end of the sheet after cutting first, and drill and tap the holes for the screws in the cylinder. Attach the sheet and then bend it snugly round the profile, mark where the end is to be cut off, after which the holes can be punched in that end and the screws fitted.

If you feel like lagging as well, the balsa wood strips are quite effective. Fibreglass is better insulation and doesn't soak up oil or water, but has a nasty habit of peering out at you from under the cleading after a while. It is not so much a question of finding a material which is a good insulator in itself, as one which traps air in a porous structure, air being an excellent insulator if you can stop it from carrying heat away by convection currents. The larger of the engines of this type would have an outer cover over the cylinder cover proper, held on usually with one central screw, with lagging inside.

Draincocks would certainly have unions thereon, with pipes to carry the blow-off outdoors, or at least into a pipe trench. The volume of steam and water discharged from an 18 in. bore cylinder at starting would fill the engine room with vapour otherwise!

Painting

The publishers have an excellent book on this subject, so that I need not say too much about this. As mentioned at the beginning, all castings should be primed when received. After total dismantling and cleaning, wash down all parts to be painted with an oil solvent, followed by paint thinners, and allow to dry thoroughly. Go round and trim off all knobs from castings, but don't get them too smooth or the paint won't grip.

I prime with aerosol spray cellulose, red, then a coat of brushed on primer-surfacer, grey, and a second coat of this, red. Then rub down with wet-and-dry paper, plenty of water, until bare metal begins to show at the high spots. The alternating colours give you a chance of noting progress. Dry off, and repeat-spray, and two coats of surfacer. This time, watch for the second red coat showing, and stop there. Dry off, and apply in thin layers, cellulose stopping, to fill any hollows. Knife this on, thinly, and let each dry before putting on any more. Spray with primer, and rub down again. Fill any more hollows revealed, spray again, and so on. As soon as examination of the dry surface shows all to be quite smooth, two light coats, but covering all, of sprayed primer, not rubbed down this time, followed by a colour coat compatible with, but not the same, as the final colour (e.g. dark green under light, etc.). Then a light spray of the final colour. Rub down with very fine (No. 420 or even 600) wet-and-dry paper till the undercoat shows, but not the primer. Then two coats of final colour, rubbed down with worn No. 600, and finally after very careful washing and drying, and at least 24 hours later, the final colour coat.

This final coat may not be cellulose, may be a brushing enamel, but I use cellulose for all the preparatory work as it is quicker, and in any case, oil or synthetic based filler is not easy to come by. I don't use any brushing cellulose.

After painting, leave it several days to set, and then rub over with Brasso on a clean yellow duster; this will "cut" the surface, and then leave a fine polish on the paint. Don't use the rubbing compound supplied by the paint makers for the purpose. It is too fierce (though it can be let down with water till very thin) and usually rubs right through the colour coat on the corners. Even Brasso will do that if you are too energetic with it! I then leave another few days before reassembling the engine complete. At this stage, too, overlong studs are shortened (though here I prefer rather to counterbore the studhole to sink the stud in a bit further if there is enough metal to allow this) and a final "closing" of any worn—or, properly speaking, bedded—bearings is done. After that—well, it looks so nice it's a pity to risk spoiling it by running it, isn't it? But if the painting has been properly done, and each coat well set before the next put on, it will stand up to steam all right—everything except paint stripper and (bear this in mind) many types of releasing oil. So, get steam up on the test boiler, and have the chaps round to listen to the even beat!

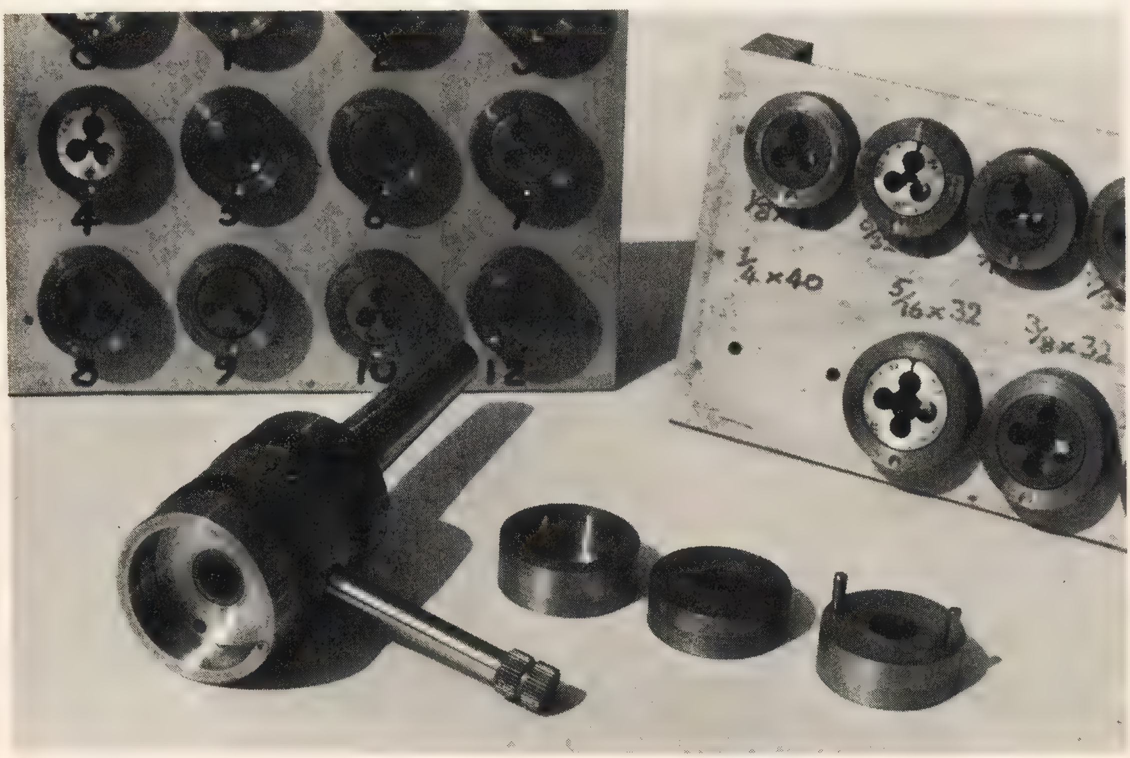
An Improved Tailstock Dieholder

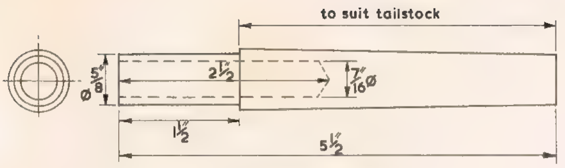
by A. J. Wise

A TAILSTOCK DIE-HOLDER is I think a must for any model engineer with a lathe and so it was one of the first tools made when I started a couple of years ago. Then I met George Joines and saw the improvement he had made to the basic design, and promptly made another one to his pattern. The time saved even in my short modelling life is far in excess of the time spent making it, to say nothing of the convenience. Just think, no more time spent changing and setting up dies—no more work spoilt because the thread is too tight or too loose. All of your dies are set up accurately in their own holders and you pick them up, slot them in, and use them, just like that.

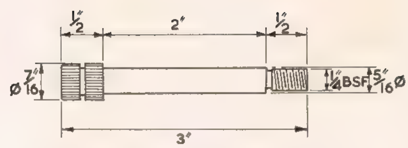
The body of the die-holder was made from b.m.s. 2 in. dia. and turned to size. It was knurled to provide a grip as an alternative to the handle when working on small threads. The body was then drilled through and bored out $\frac{5}{8}$ in. One end was then counterbored 1 7/16 in. dia. x $\frac{1}{2}$ in. deep and the other end $1\frac{1}{4}$ in. x $\frac{3}{8}$ in. deep. (The body could be counterbored one end only for the large size and use the large holders for both size dies — but I preferred the two sizes). The side is marked for centre, drilled and tapped $\frac{1}{4}$ in. BSF for the handle, a seating being provided by an end mill or counterbore. This finishes the body for the time being.

The shank is b.m.s. $5\frac{1}{2}$ in. long and taper turned to fit the tailstock. Mine has a No. 2 Morse taper and this is easily obtained by setting over the top-slide. Hold a mill or drill with a No. 2 M.T. shank in the chuck so that the M.T. is projecting, then with a D.T.I. in the toolholder (set at centre height) traverse the top-slide along the Morse taper gradually correcting the set-over until the D.T.I. reads zero over the full length. Replace the drill with the mild steel and set the tool in the holder at exactly centre height, then

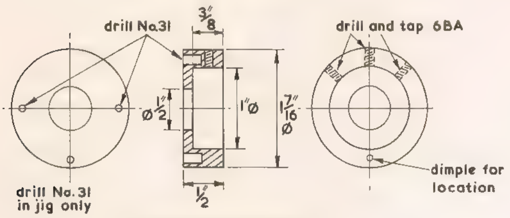




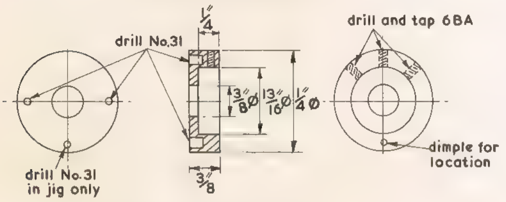
DIE-HOLDER SHANK



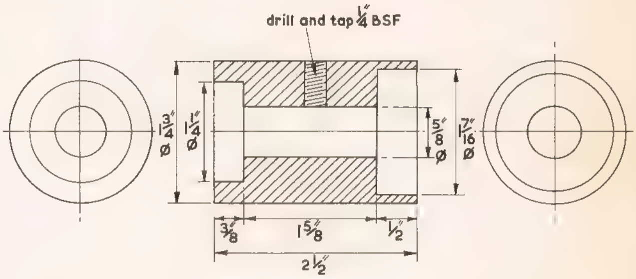
HANDLE FOR DIE-HOLDER BODY



LARGE DIE-HOLDER



SMALL DIE-HOLDER



DIE-HOLDER BODY

using the top-slide to traverse the tool, turn the taper. When complete fit the taper into the headstock mandrel and turn the shank to fit the die-holder body ⅝ in. dia. x 1½ in. long. Drill the shank 7/16 in. for a depth of 2½ in. and if desired right through with a smaller drill to enable longer threads to be handled. This finishes the shank.

The handle is b.m.s. ½ in. dia. x 3 in. long turned to shape and size as per drawing and threaded ¼ in. BSF.

Then comes the tedious part—making the individual die holders. The large ones are made from 1½ in. b.m.s. turned down to 1 7/16 in. dia. and parted off ½ in. thick. If the bar is accurate, use the full diameter and bore the body accordingly. You will want one for each die plus one for a jig; it is as well to do some spares for future dies while you have the set up. The small holders are from 1¼ in. b.m.s. parted off ⅜ in. thick, again one for each die, plus jig, plus spares. Either the holders should be turned to fit the body or if the full size of the bar is used, the body should be bored to fit. The holders should be a close fit, so that they will shake out but not shake about. Each holder then has to be drilled and bored. The large ones drilled ½ in. through and bored 1 in. x ⅜ in. deep for dies to fit. The small ones are drilled ⅜ in. and bored 13/16 in. x ¼ in. deep for dies to fit. If the drilling is done before the parting off, it will make that operation easier. The counterboring can be done as a separate job afterwards. Leave one of the holders in each size solid as a jig.

Taking the large jig first, mark out and drill 3 x No. 31 holes ⅛ in. in from the edge as shown on the drawing, then on the side scribe a line across the position of the holes for the adjusting screws, taking the spacing from a die. Mark one face of the jig as a reference. Take the jig and drop it into the appropriate end of the die-holder body and clamp in position, marked face outwards. Drill the two holes one at each side ½ in. deep and centre dot the edge of the die-holder body adjacent to the third hole. This indicates which way round the die-holder goes when in use. Repeat this operation with the small jig. Then open out the two holes at each end of the body to ⅛ in. and just touch the centre dot marks with the drill to make a neat dimple at the indicator marks. The body is then finished.

To finish the die-holders, clamp the jig to a holder with the marked face of the jig in contact with the back of the holder, then drill the two holes for the pins No. 31 x ¼ in. deep on the large holders and 3/16 in. deep on the small holders. Turn over and centre dot the edge of the face of the holder, on the side adjacent to the third hole, as an indicator mark. Turn on side and transfer the marks for the adjusting screw holes,

drill and tap these 6BA for grub screws, and dimple the indicator marks. Cut some ⅛ in. b.m.s. rod ⅝ in. long for each locating pin on the large holders and 9/16 in. long for the small holders. I tested some lengths of ⅛ in. rod and found one which was just a nice press fit for the No. 31 holes. When cut, press the pins into the holes, being careful not to bend them and also that less than ½in. projects to avoid fouling the bottom of the locating holes. Fit three 6BA grub screws —socket head type to each holder, place the die in the holder and adjust to accurate size and the job is done.

I can assure you that every time you use this tool you will wonder how you ever managed without it, and having correct sized threads is a joy that is there every time, without the work usually associated with it. It is certainly too good an idea to keep to myself and a few friends that have made them, so join the club and make life easier for yourself.

JEYNES' CORNER

E. H. Jeynes talks about "Steam"

I was recently asked by a correspondent if I had ever heard of an American steam plant called the 'Buckeye Locomobile', which he intended to model if he could find a prototype or drawings to scale down, as he had worked in a sawmill powered by one many years ago. The 'Locomobile' seems to have originated in Germany, being known as the Woolf engine; some were built in this country, and the Buckeye Locomobile was the first American version to be built in that country.

I have the specification of the Buckeye, but no drawings or any dimensions; possibly some reader might be able to oblige. The Buckeye was a self contained steam plant, comprising a boiler with a marine type furnace with a combustion space beyond the firebars, and where the usual smokebox is situated there was an extension of the boiler shell with heat insulation, in which were situated the superheater, and reheater. This extension was also carried upwards to enclose the cylinders so that they were exposed to the hot flue gases. The engine was a tandem compound mounted directly over the boiler, a saddle supporting the frame to which the engine bed was bolted, so arranged to allow for the unequal expansion between boiler and engine. An air pump and boiler feed pump were fitted.

Steam was led from the dome to the rear end of the superheater, leaving it at the front end going straight up to the high pressure cylinder; this exhausted into the front end of the re-heater, leaving it at the rear end going straight up to the low pressure cylinder, which in turn exhausted into the feedwater heater, and after passing through this, entered the condenser.

It will be seen that the whole comprised a sort of package plant of comparative large horsepower, not requiring massive foundations or brickwork, able to be controlled by one man, economical with water, and able to burn the waste when installed in saw-mills. I have seen a photograph showing two of these engines direct coupled to large generators on concrete pillars about 8 feet high, looking very odd. Some of these plants were capable of developing several hundred horsepower. I have never seen a model of one of these, though possibly someone has built one.

While still on the subject of steam, I have just received a letter having reference to my article of January 3rd in which the writer offers some constructive criticism on my remarks regarding the insertion of an oscillating plate worked by an eccentric between the cylinder and steam block of an oscillating cylinder engine. He takes me to task on the remark I made, "that I cannot see how the porting events could be improved by it as shown". My correspondent however sees great advantage in the idea, I quote:— "Now timing events are late on an engine of this type all round: a valve plate of this type allows lead steam, and at the same time, and more important, pre release allows the pressure to get out of the cylinder before the piston starts its return stroke; a little cut off is incidental to it. Due to the short direct ports possible in an oscillating engine, and the minimal clearance volume, I believe the use of this "advance plate", plus the use of 'Keystone' (Tapered), ports would make a real powerful engine out of it."

My correspondent, who incidentally omitted his address, has evidently given much thought to the idea, and I would be pleased to hear from anyone who has studied whether any advantage can be gained by adding the extra friction of two port faces, an eccentric strap, and a rod pin joint, which I think would outweigh any gain. Of course the pressure in the cylinder can be released when the piston reaches the bottom of its stroke by the simple expedient of auxiliary ports, and any lead could be gained by the gentle filing of ports; at least, I think so, without the expedient of adding all the extra friction I mentioned above. Of course lead could be obtained when designing the portface.

Finally, I think a link and die block would be necessary, with a controlling lever etc., to ascertain the exact amount of lead, and to maintain it as wear became apparent in the eccentric and associated gear.

"FURY" DRAWINGS

LO 942. Sheet 3:— Coupling rods, arrangement of inside motion, inside cylinder and details, simpling valve.

Sheet 4:— Inside valve gear, inside crosshead, inside motion plate, outside cylinders and details.

Price 70p. each inclusive of VAT and post.

"FURY"

A High Pressure Compound Locomotive for 5″ gauge

by Martin Evans

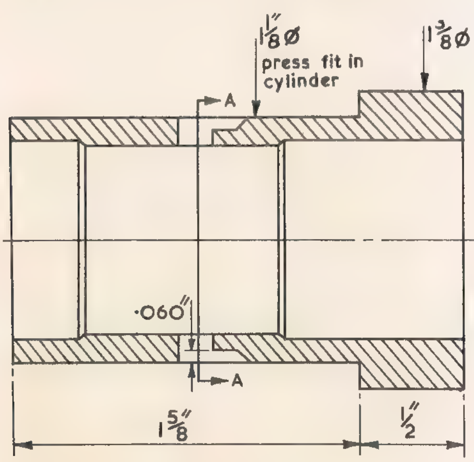
Part X — **The outside motion** — *From page 341*

BEFORE continuing with the description of the outside motion of *Fury*, a few words on the question of the "backset" of the expansion link, which is necessary in Walschaerts valve gear in order to get even swing and therefore equal port openings at each end of the cylinder. I have mentioned more than once that the amount of backset can be established quite quickly on the drawing board by trial and error, but the results are often quite unexpected. I feel sure that a mathematical solution for this dimension is possible, even though there are several "variables", and it has always been a surprise to me that one of our readers who is a much better mathematician than I has not come up with a suitable formula.

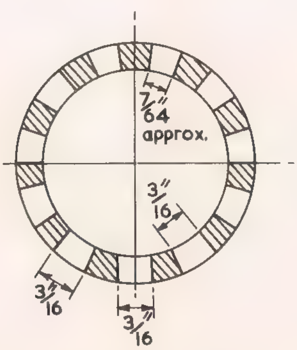
The other day, I picked up my copy of Professor Dalby's "Valves and Valve Gear Mechanisms", expecting to find something of interest. But I was quite disappointed, the Professor does not mention backset at all. Further, I was surprised to find no mention of the different arrangement of the combination lever in Walschaerts gear according to whether the gear is for outside or inside admission, all Dalby's drawings referring to outside admission and slide valves. Perhaps this is because at the time the book was published (1906) piston valves were very much in their infancy.

Professor Dalby's instructions for designing Walschaerts valve gear are what might be called the "equivalent eccentric" method, where the two components of the motion—one obtained from the return crank or eccentric and one from the crosshead via the combination lever—are combined. While this is precise, I much prefer the late Henry Greenly's method, where he ignores the crosshead motion as far as full gear is concerned, and takes the travel of the valve in full gear as being produced by the return crank only. Although this introduces a slight error, I find it a much more convenient design procedure, and every one of my locomotive designs having Walschaerts valve gear has been produced by

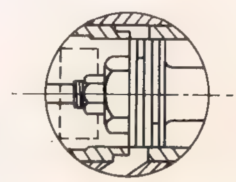
Below: Corrected drawings of piston valve heads and liners.



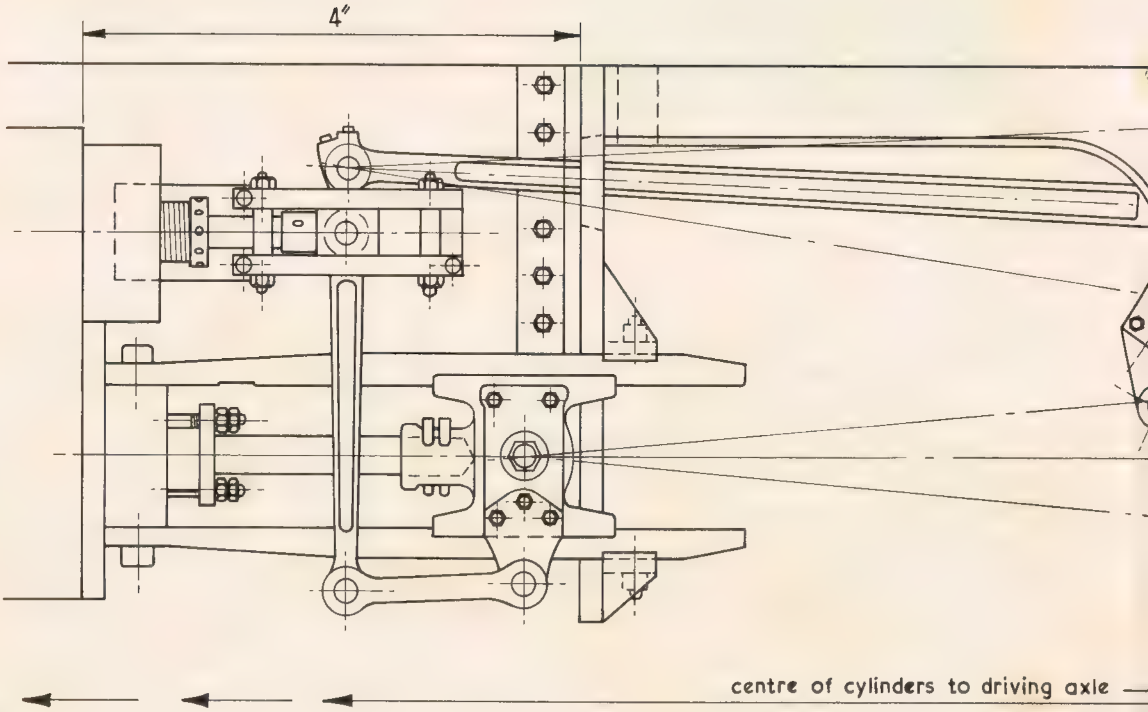
PISTON VALVE LINER



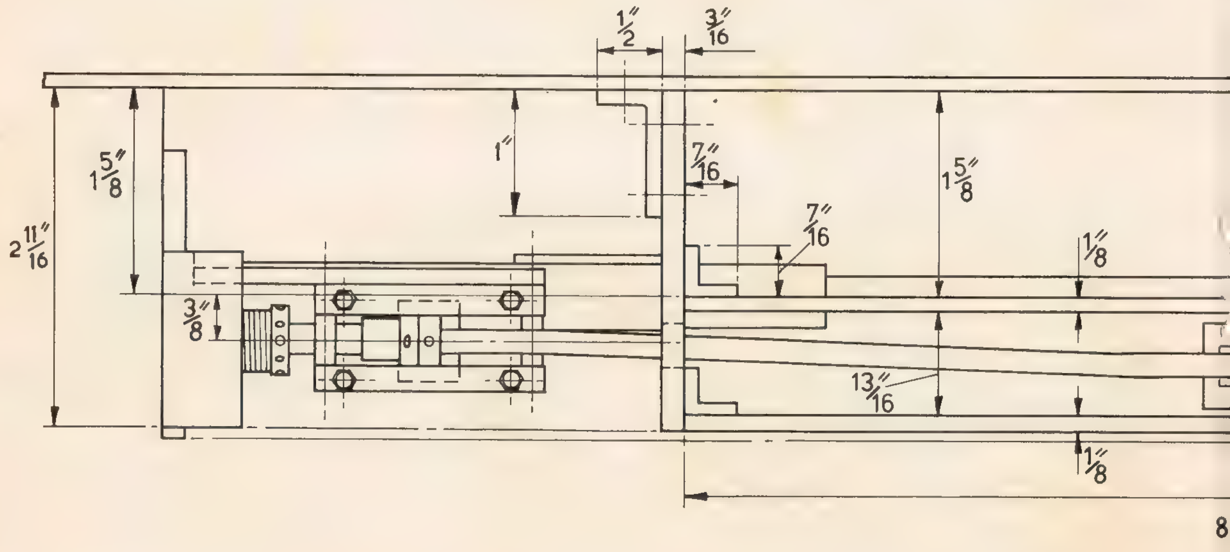
Section AA

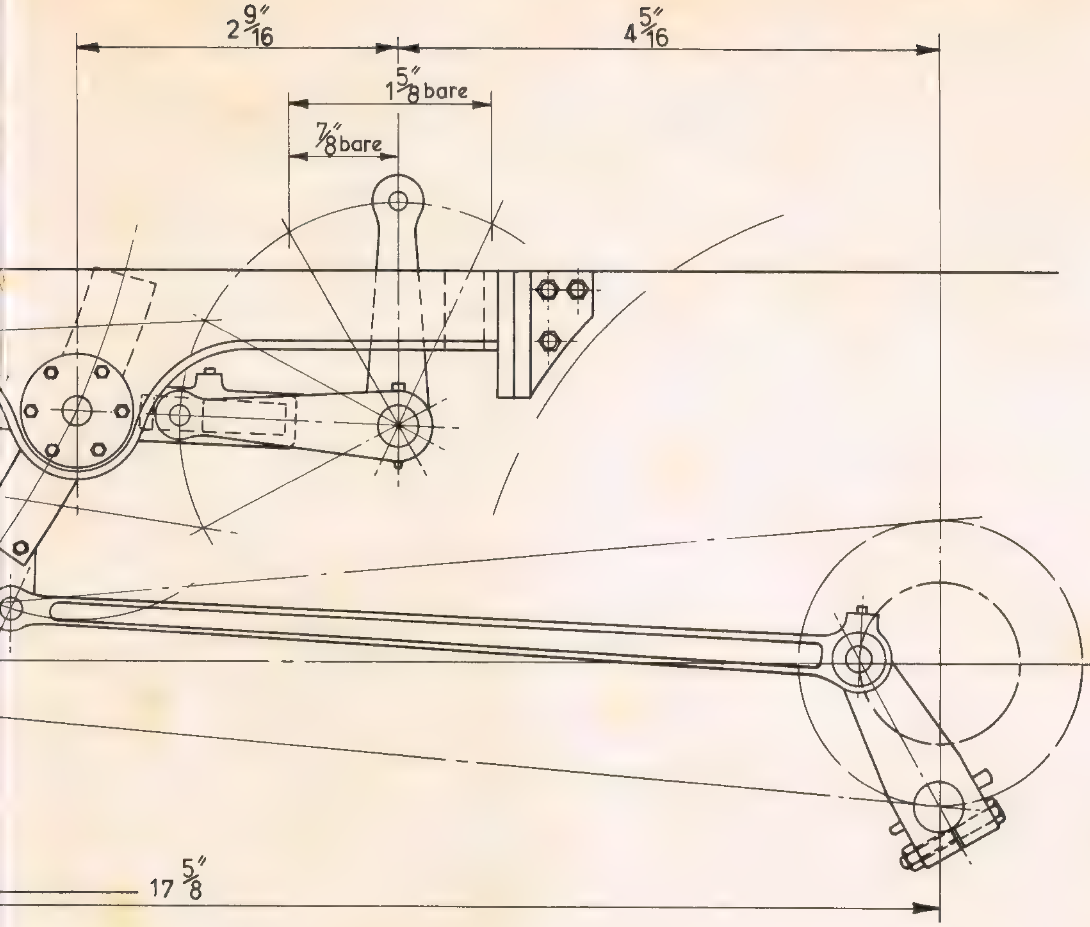


Scrap view of piston valve head



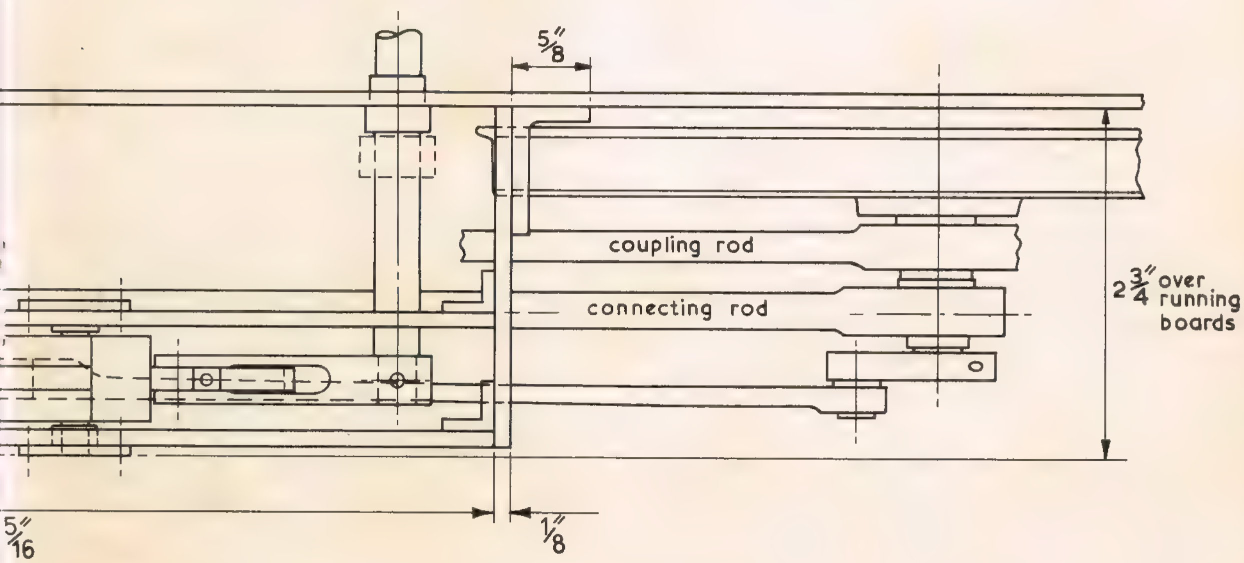
ARRANGEMENT OF OUTSIDE VALV





2 9/16″
4 5/16″
1 5/8″ bare
7/8″ bare
17 5/8″

E GEAR



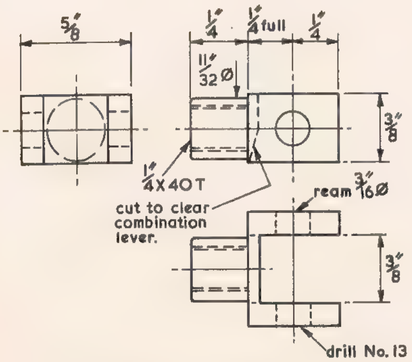
5/8″
coupling rod
connecting rod
2 3/4″ over running boards
5/16″
1/8″

this method. The error is in fact only a slight increase in valve travel if the valves are for inside admission, or a decrease if they are for outside admission.

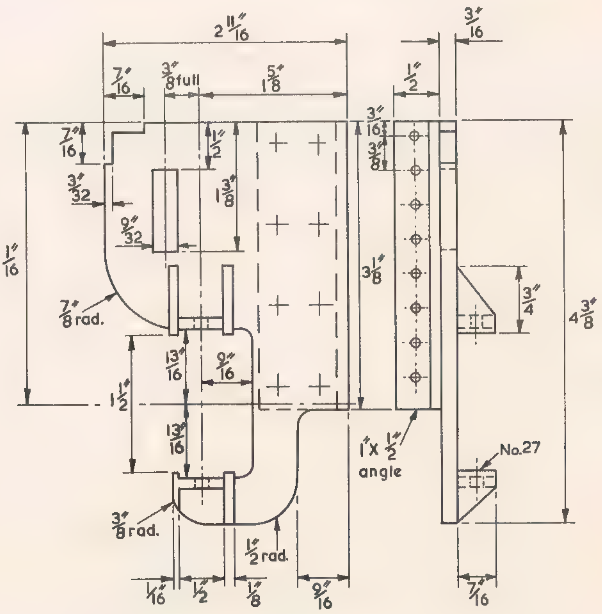
Outside connecting rod

The outside connecting rod might be tackled next. It is cut from the 1½ in. × 3/8 in. b.m.s. Having marked out one rod, the two can be clamped together and drilled for big and little end bearings. The fluting is essential for good appearance, but need not be done on both sides. Myford users may have a little problem with the flute, which is approximately 11¼ in. long—longer than the travel of the cross-slide. However, it can be done in two stages, the rod being shifted after about half the length of the flute has been milled. If care is taken, the "break" will hardly show, and a little careful filing afterwards should hide all traces. A few weeks ago, I carried out an identical operation on my *Nigel Gresley* connecting rods, which are even longer than *Fury's*, and had no real trouble. I used the usual heavy steel angle bolted to my vertical-slide, and a staggered tooth Woodruffe cutter in the 3-jaw.

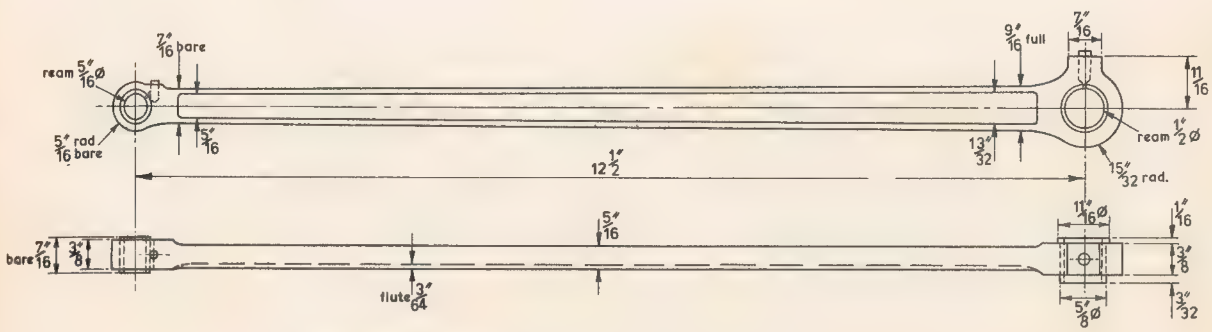
The tapered flute was obtained without difficulty by swinging the rod on the bolt holding down the little end of the rod, and re-clamping the big end. A trial cut should be taken, as this will have to be machined away after the fluting



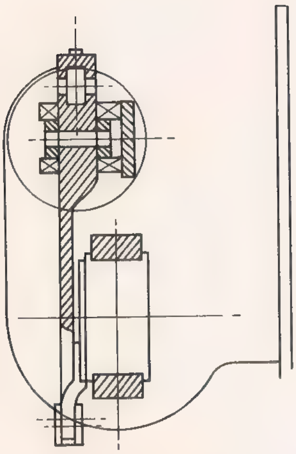
OUTSIDE VALVE CROSSHEAD
2 off B.M.S. caseharden (2 X FS)



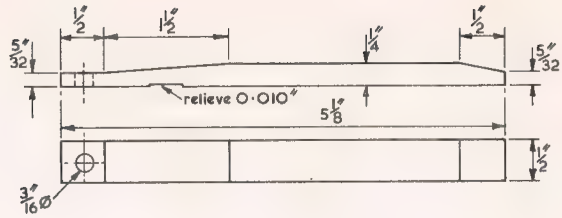
OUTSIDE MOTION PLATE L.H. drawn B.M.S.



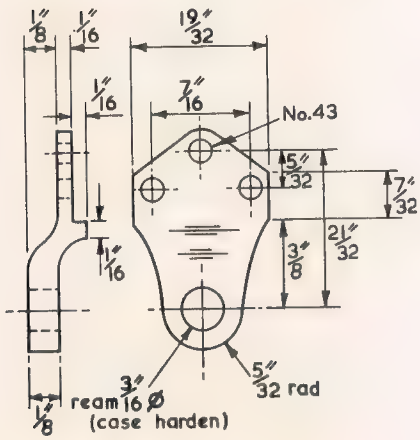
OUTSIDE CONNECTING ROD L.H. drawn B.M.S. bushes ph/bronze



COMBINATION LEVER ASSEMBLY



OUTSIDE SLIDE BAR 4 off steel



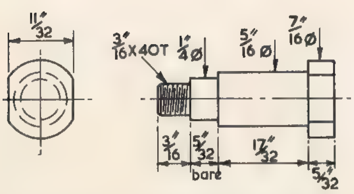
DROP LINK 2off BMS (2XFS)

has been completed, the rod being only 5/16 in. thick between big and little ends.

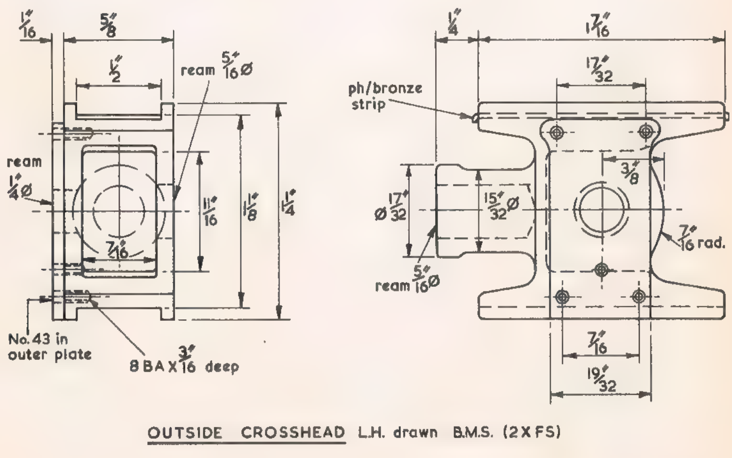
I do not need to say anything about the outside slide bars, which are identical to the inside one, apart from the greater length. They are cut from ½ in. × ¼ in. b.m.s. and may be case-hardened.

The outside crossheads, also, are identical to the inside crosshead, except that the distance between the slide bars is 1/8 in. more. Again, mild steel can be used, and it is advisable to case-harden the bottom slipper (or both top and bottom slippers if the phos-bronze shim is not being fitted).

The crosshead gudgeon pin could be machined from silver steel, or from mild steel case-hardened, though I would prefer something more "sophisticated" such as EN.33 or EN.36B if available. A plate made from 1/16 in. b.m.s. is bolted to the outside of the crosshead, and the valve gear drop link bolts outside this, 8 BA hexagon-head screws being suitable here. Care should be taken with the upper tapped hole for the drop link that the tapping size drill does not break as it passes through into the small end recess. To make sure that the drop link doesn't work loose in service, a 1/16 in. dia. silver-steel dowel should be put in between the two lower screws.



GUDGEON PIN FOR OUTSIDE CROSSHEAD
2 off hardened steel (2 X FS)



OUTSIDE CROSSHEAD L.H. drawn B.M.S. (2 X FS)

The valve crosshead is made from 5/8 in. × 3/8 in. b.m.s. Its boss can be turned using the 4-jaw, after which it is drilled 7/32 in. and tapped ¼ in. × 40t. After slotting the crosshead 3/8 in. wide to take the combination lever, it will be necessary to file the lower part, as shown, to clear the combination lever at its maximum forward position of swing. When this has been attended to, the valve crosshead can be case-hardened.

Perhaps the best way to make the drop link is to machine it from ¾ in. × ¼ in. material, rather than to try to bend it from thinner metal. The 3/16 in. diameter hole for the anchor link should be reamed and afterwards case-hardened.

Motion Plate

The outside motion plate could be made from 3/16 in. b.m.s. plate with the slide bar brackets brazed on, or maybe our usual castings people will be able to supply castings. If a built up construction is preferred, it will clearly be very difficult to braze on separate triangular pieces to make the slide bar brackets, as it would be almost impossible to hold them in position. The best way to go about it is therefore to machine these brackets completely from the solid, a section of steel 5/8 in. × ½ in. being used. They can then be clamped lightly against the motion plate by home made clamps while the brazing is carried out. The grooves or recesses to receive the slide bars should be left a bit undersize when these brackets are fitted, being finally milled or filed to size after the brazing operation has been completed.

The motion plate is held to the main frames by a length of 1 in. × ½ in. steel angle, eight 6 BA hexagon-head screws being used, into tapped holes in the frame. After the motion plates have been bolted in position, try the slide bars in place and make any necessary adjustments. It is quite in order to use shims between the brackets and the slide bars, if necessary to obtain correct alignment. Then check that the crossheads, with their drop links, do not foul the outer bottom radiused corners of the motion plates, as there is not a great deal of clearance here.

The arrangement drawing of the valve gear shows how the expansion link is supported, a framework of 1/8 in. thick steel plate being bolted up to the motion plate at the front end and to a bracket made from steel angle at the rear. The ½ in. × ½ in. angles at each end of the inner plate might with advantage be riveted to the plate, screws being used to hold the front angle to the motion plate, and the rear angle to the rear bracket. This would make it easier to assemble the radius rod and expansion link.

Builders who like detail work can fit a half-round beading along the lower edge of the outer plate of the link supports.

A ONE-INCH SCALE STEAM WAGON

by R. H. Dyer

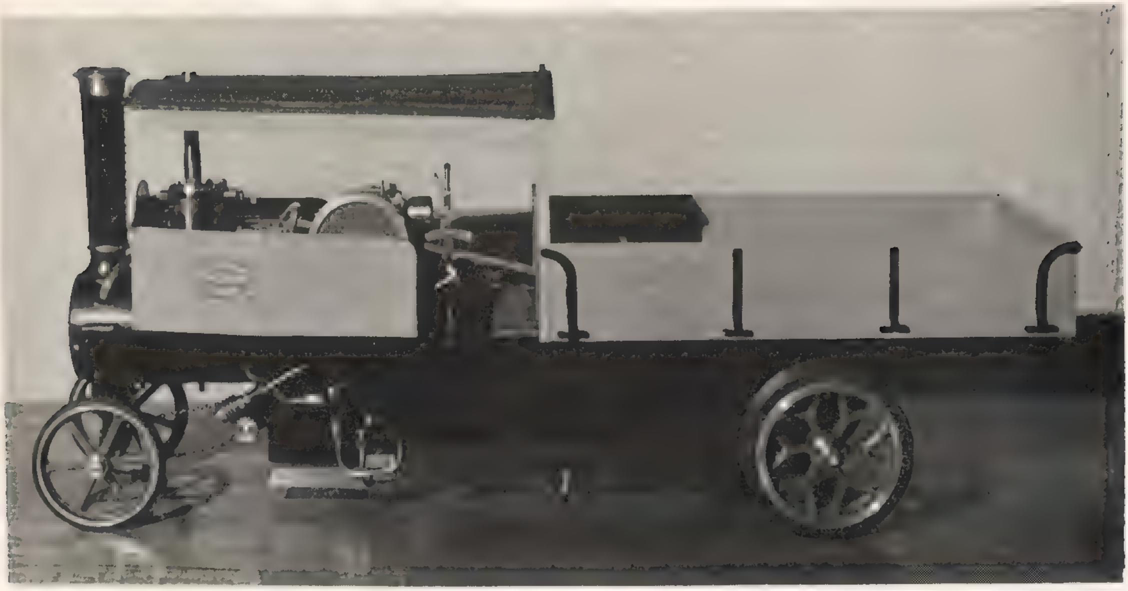
IT IS VERY REFRESHING to see in *Model Engineer* such delightful little models as Mr. R. Kirke's tandem steam roller or Mr. R. Kouhoupt's Frisk traction engine (M.E. Nos. 3423, 3488). It must be a hard fact of life that some M.E. readers have neither the time or the funds to build large 3 and 4 inch scale models and this contributor for one is pleased to know that some modellers are content to build vehicles which can be held in one hand and parked on the sideboard.

I have recently completed a small steam wagon and offer this article in the hope that readers will be interested in this addition to the model engineering (as opposed to light engineering) world!

I was obliged to build small as my Unimat lathe is more suited to 'O' gauge railways than live steam. However, the machine came through with flying colours so, to all you Unimat owners, if live steam is tempting you, proceed with confidence.

The model was designed around the Mamod steam wagon wheels which were kindly supplied by the manufacturers. A search through the book "The Overtype Steam Wagon" revealed drawings and photographs of an Aveling Porter 5 ton wagon with almost identical wheels, so I used this prototype as a basis for my model.

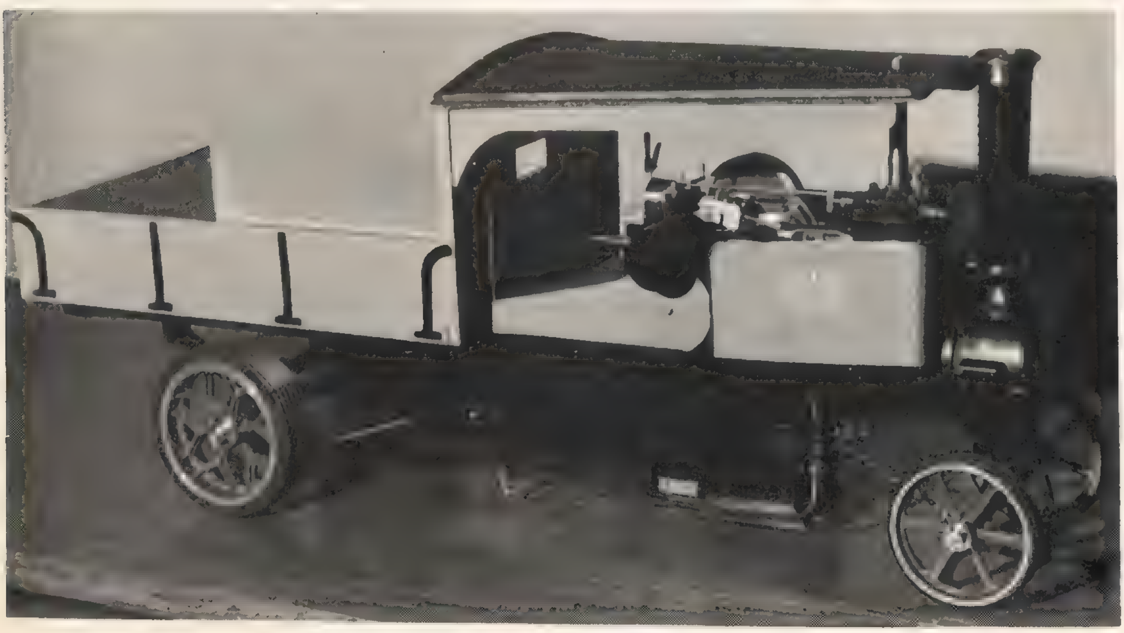
Being a draughtsman by trade, I had an enjoyable time designing and drawing the major assemblies and being my first live steam model I avoided a lot of complication by providing only one cylinder and mounting it on a bridge piece straddling the boiler. I reasoned that as the engine was well hidden behind screens the departure from scale would not be too obvious. Lining up of the moving parts was also made very much easier.



Construction was commenced in June, 1973 with the fabrication of the main chassis, made from ½ in. x 3/16 in. mild steel screwed and then brazed. The smokebox cradle, a casting on the original, was also fabricated and a large brass bush was sweated in position to receive the axle fork. The main axle was shaped from rectangular bar with stub axles of 3/16 in. dia. silver steel inserted in each end and retained by the steering chain pins.

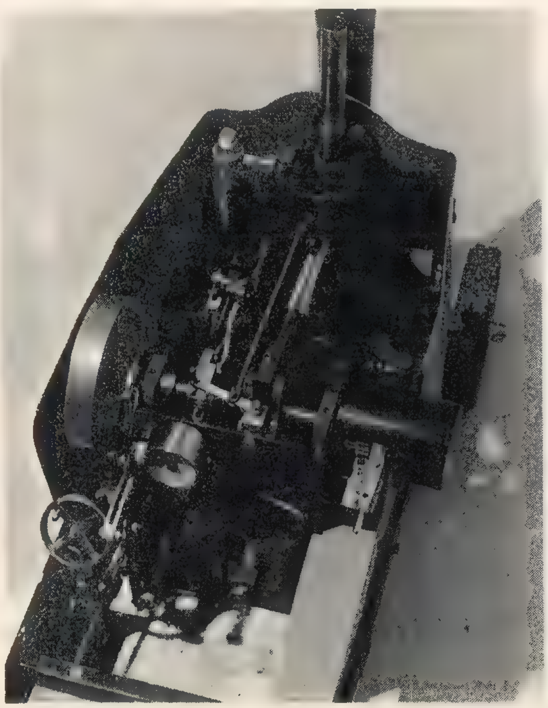
I devoted a lot of thought to the rear suspension; I would have preferred a sprung rear axle and in fact I messed about with some spring steel strip, but did not feel confident about heat treatment. In the end because the delay was slowing up the whole job I made dummy leaf springs fitted with brass axle bushes. This is the least satisfactory part of the whole job but could be modified at a later date.

The rear axle is made from 3/16 in. dia. ground mild steel bar, the ends being turned down to ⅛ in. dia. for the brass hub caps. By packing up



The chassis of the steam wagon, showing the transmission.

Below: A view of the cylinder and motion.



the lathe headstock by $\frac{1}{8}$ in. I was able to mount the rear wheel castings on the faceplate to bore them out to fit the axle. The hub caps are pinned to the axle; the nearside wheel revolves free but the offside cap is fitted to the wheel thus transmitting the drive. A Meccano sprocket mounted on a hub completes the rear axle assembly. All the wheels are shod with solid rubber tyres secured to the wheels with Evo-stik.

The hornplates were cut from 16 SWG mild steel sheet and are attached to the chassis rather than the boiler. The crankshaft holes are slotted upwards so that by sliding the trunnions inwards the whole crankshaft assembly can be removed.

The crankshaft itself is $\frac{1}{4}$ in. dia. silver steel with stainless steel webs. These were silver soldered in position and the shaft sawn away from between them. By great good fortune the shaft still ran true afterwards. A Mamod flywheel is mounted on the nearside and has its spokes concealed by two steel discs. The offside end of the shaft carries a hub to which are soldered a pair of modified Meccano pinions. A 1/16 in. dia. pin passes through the shaft and through a slot in the hub, thus transmitting the drive while allowing the pinion assembly to slide left and right for gear changes. Below the pinions the second shaft wheels are also soldered to a hub along with a small Meccano sprocket, and a chain transmits the drive to the rear axle.

The overall gear ratio is unfortunately rather low (the entire transmission was made up from a Meccano gear kit) and the model has a tendency to charge around throwing the fire out of the chimney in all directions.

The boiler was designed using L. C. Mason's "Minnie" handbook, the barrel being 2¼ in. dia. and fitted with 6 firetubes ⅜ in. O/D. The smokebox is part of the boiler barrel and extra water space has been gained by moving the smokebox tubeplate forward from its scale position. The Aveling smokebox door is virtually the same size as the smokebox so on the model a spigot was turned on the door to locate it in the barrel. The various boiler plates were flanged over formers cut from 12mm plywood and the assembly was silver soldered with Easyflo No. 2 using a 1½ pint paraffin blowlamp.

A small steam manifold is fitted which accommodates the blower offtake, pressure gauge offtake and water gauge top fitting. The blower pipe is led through the boiler to the base of the blast pipe.

All the firebox stays were threaded 6BA and were caulked with Comsol H.M.P. soft solder, using Bakers fluid for flux. Once I had overcome the problem of achieving steamtight fittings which also pointed in the right direction, the boiler successfully passed a hydraulic test to 140 p.s.i.

The cylinder block is machined from a lump of phosphor bronze donated by a kind friend many years my senior who is an amazing source of helpful hints and tips. The steam chests are machined from brass. Steam enters the regulator chest via a union on the boiler and a short connecting pipe. Cylinder and motion are based on the "Minnie" drawings, as should be clear from the photographs, but with a bore and stroke of ½ in. x 13/16 in.

In June, 1974, the engine was run for a few seconds at a time on a boilerful of compressed air. Like most first-timers I found this was quite startling—a steam engine designed and built by me actually worked! A steam test was the next job and I set about making the parts needed—chimney, handpump, ashpan and grate, etc. A complete day was spent making a blower (sucker) which runs off a model railway transformer. I had no idea how solid fuel would behave in my tiny firebox (2¼ in. x 1¾ in.!) but I had by me some steam coal, household coal and charcoal. So it was blower on, in with the paraffin soaked wood and a lighted match and we were away. A good fire was achieved with charcoal which I was able to maintain with the steam blower or by running the engine. Both household coal and steam coal were fairly successful if broken small, although constant vigilance was required. Another item which was obviously also required was a mechanical pump—a constant round of hand pumping was required without it.

The chimney, which hitherto had been a piece of copper pipe, was replaced with the correct article rolled from a piece of 32 SWG brass sheet and riveted down the seam. A cap, turned from brass, was slid to the top of the chimney and secured with Loctite. The addition of a proper chimney made a remarkable improvement in the appearance of the wagon.

Bodywork was made from offcuts of plywood with a canopy roof of hard 3/32 in. balsa. This has an old cotton handkerchief doped on to simulate fabric covering. The various planking joint lines were scribed on and dummy strapping and hinges were made and glued and pinned in position. A trapdoor in the floor gives access to the water tank and the rear of the cab is also removable.

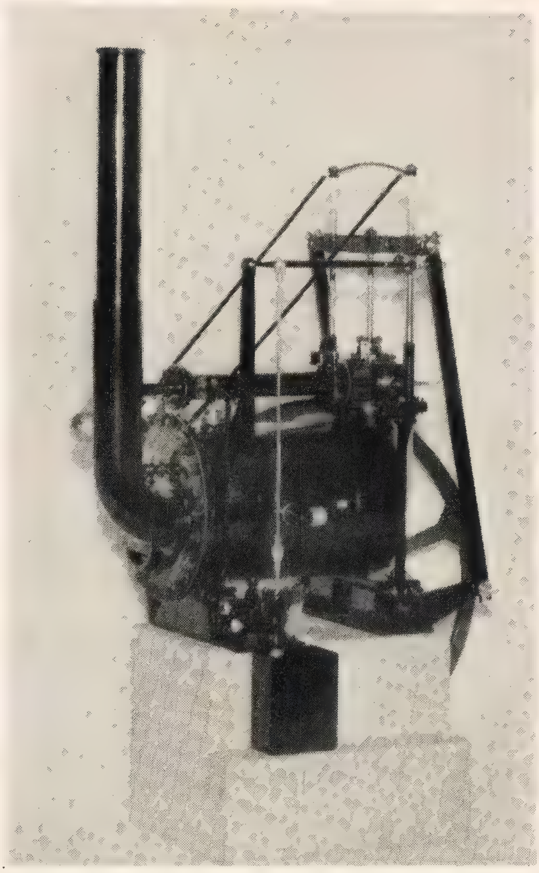
The mechanical water pump was now made, having first been laid out four times full size on the drawing board. The bore and stroke are 3/16 in. x ¼ in. with the ram acting vertically driven from an eccentric behind the flywheel. Fortunately I had provided a spare bush on the boiler barrel matching that on the other side for the handpump clack valve. Accordingly a second clack was made, also a bypass valve. This latter fitting proved difficult to site, the footplate being somewhat crowded, but it was eventually positioned below the steering wheel. Much to my relief the pump worked, although it would probably be more efficient if it was geared down from the engine.

The wagon was steamed and run several times, chuffing round in hasty circles, but the time had come for painting and so the whole thing was stripped down to the bare frame—a sight I had not seen for many months.

The boiler was lagged with felt and a nickel silver cleading sheet, then sprayed with Holts grey zinc primer and heat resistant black paint. Other steel parts were sprayed with white cellulose primer and brush painted. Basically the wheels are red, boiler and frames black and the body Humbrol French Blue. In December, 1974 the wagon was screwed back together again, hopefully with everything in exactly the same place as before. It was several weeks before I dared to light a fire again but eventually I did and the paint did not bubble off the smokebox structure. Altogether the model has taken 18 months to build but an actual construction time of only some 350 hours.

A Model of Trevithick's Steam Engine

By George A. Dimelow



At the beginning of the nineteenth century high pressure steam engines began to take over from the atmospheric engines of Newcomen and Watt, which had provided power for almost a hundred years. In Britain Richard Trevithick was a pioneer in this field and took out a patent for a high pressure engine which was very advanced for the period. This engine had many unusual features which make it an interesting subject for a model.

Before beginning construction a scale had to be chosen. I decided to use one inch to the foot, mainly because this would mean an eight inch flywheel which was about the largest I was able to turn.

The boiler is the key section of the engine, as every other part is in some way fixed to it. An unorthodox feature is the fitting of the vertical cylinder which is sunk into it at the top. This required a semi-circular bulge to be formed at one end, which I decided to develop by working sheet copper over a simple mild steel former. By annealing at frequent intervals it was possible to form the complete end from one piece. The firebox and flue tube were straightforward silver soldering jobs, consisting of a brass tube running from the fire door to the rear of the boiler joined to another tube leading back to the chimney.

When it came to making the valve gear some tricky drilling and prefabricating were called for. A rotary cock distributes steam alternately to either end of the cylinder and then to exhaust. This is operated by a hand lever which is tapped up and down by a plug rod which is connected to the crosshead. Unlike the slide valve, which seals by steam pressure, this type had to be lapped in to ensure a good fit.

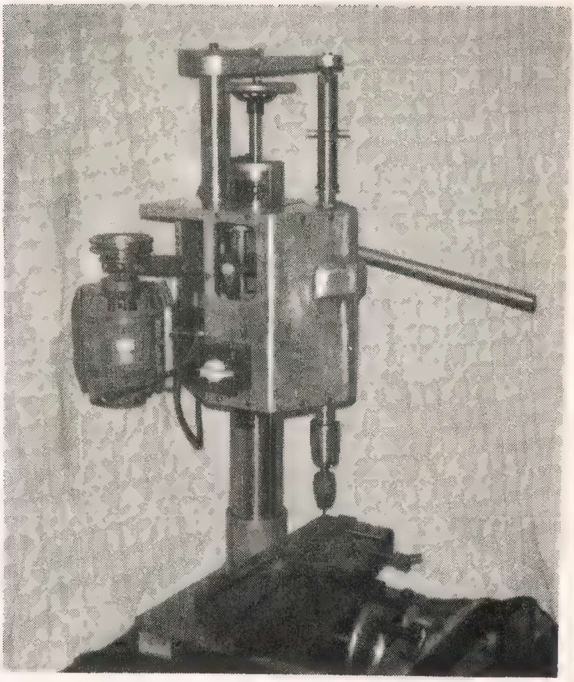
Stage by stage the engine grew and soon it became a maze of tubes and tie-bars. I had hoped to find some 'I' section mild steel for the connecting rods, but this was not to be and so I machined them from square. In view of their small size this seemed better than soldering strips together. It was vital to make sure that they were of equal length and that the throw of the cranks also were equal. The flywheel was cut from a piece of 3/16 in. mild steel plate in preference to attempting any sort of casting.

When all the parts had been assembled I decided to change the hexagon nuts and bolts for the more authentic square ones. This created some difficulties because it is much easier to get a spanner on a hexagon nut than a square one in an awkward corner. The assembly complete, all that remained was to build a suitable plinth. At first I tried to cast one in concrete, but this did not give satisfactory results. Finally I used an asbestos compound which looked convincingly like stone but could be drilled and cut with a saw.

Now came the moment of truth. The preliminary tests had been carried out and the engine was ready to be steamed. Because the firebox is rather small a gas burner was used instead of coal. I pushed the lighted burner through the fire-door and a few seconds later the front of the engine was enveloped in flames! After a few minutes thought it became clear that the cause of the trouble was insufficient air passing under the fire-door. A modification to the jet on the burner solved the problem and I was able to try again. This attempt was more successful. Steam pressure built up and when I pushed the valve lever the engine clanked into life. In the past I had used compressed air with my engines but in this case it was well worth using live steam.

A Simple Milling Machine

by A. R. McKenzie

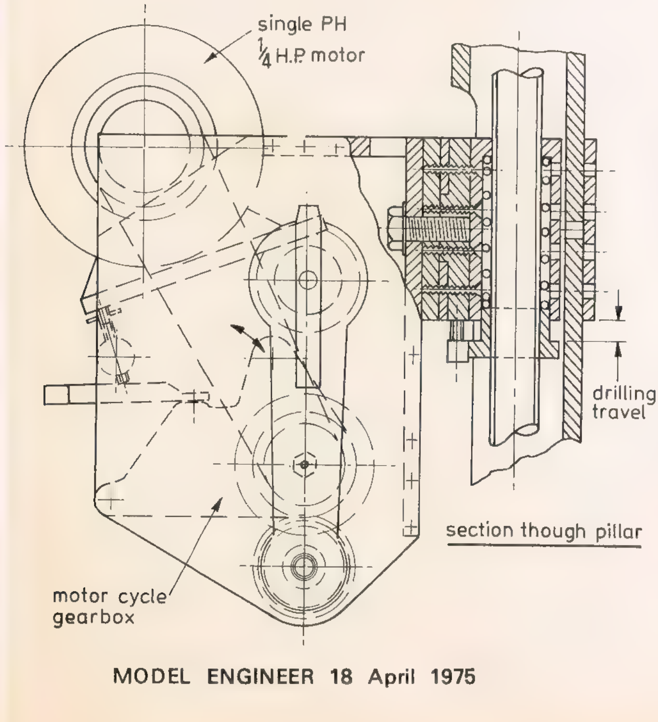


As a restorer of old motor-cycles, with an inclination towards simple model projects — all when time allows — I was presented with the problem of milling small parts in my garage workshop. From previous design experience, I could start from first principles to design a machine to satisfy my needs.

The Milling Head

Examining standard milling machine design, I discovered that if one fulcrumed the milling head in the correct place, it could be swung through 90 deg. to gain the benefit of horizontal and vertical milling off the mainshaft without major adjustments. Plans started from a three-speed vintage motor-cycle gearbox and the milling head was designed around this.

The case was of two piece welded construction, the gearbox sitting between a fixed and eccentric shaft, thus allowing for disengagement of this indirect drive to the main shaft and belt tension release. A $\frac{1}{4}$ h.p. standard motor was seated on a mounting plate fulcrumed on the 2 in. diameter overhead arm driving the gearbox through a two speed pulley. The gearbox hand change gave a six speed range of 140, 270, 390, 450, 480 and 660 r.p.m. The third motor pulley drove the mainshaft direct — with gearbox disengaged — to give an albeit low present speed of 2600 r.p.m. for grinding. The $1\frac{1}{4}$ in. dia. mainshaft was machined to take No. 1 international tapers either end, running in opposed thrust races and driving a 1 in. dia. silver steel arbor which was supported by an aluminium casting for the drop arm.

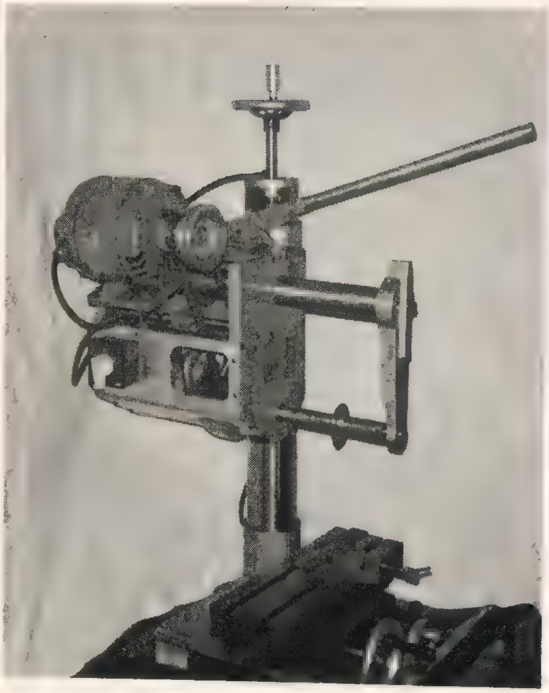


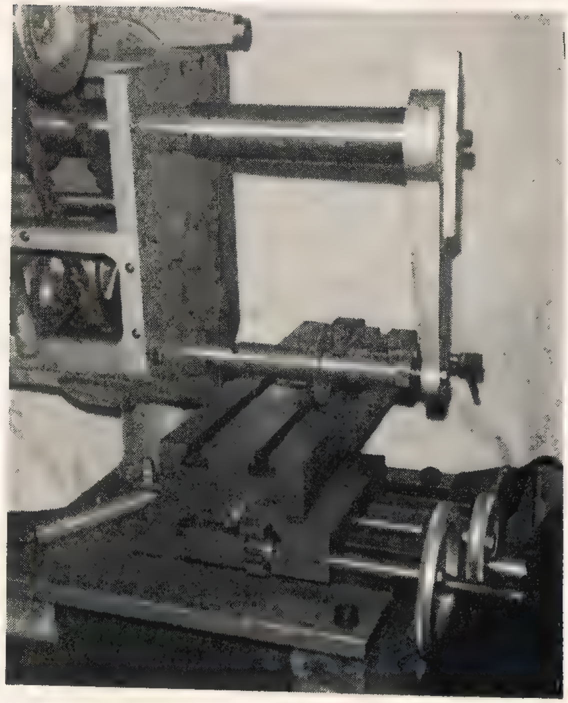
Pillar and Table

The main problem was how to support the head on a pillar rigidly and still have a small travel for drilling plate up to 1 in. thick. It took a bit of packing in as can be seen in the sectional view, but works very satisfactorily. The pillar was made from $\frac{1}{2}$ in. wall, 4 in. diameter pipe and screw drive by a scrap lathe lead screw supported on thrust and ball races, giving a lift of 12 in. This unit fitted snugly into a corner mounting on the baseplate which remained of simple lightweight design to allow initial project completion.

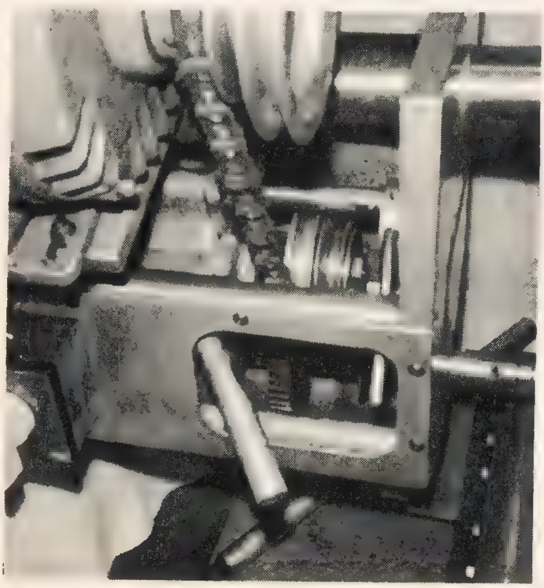
The table and bottom slide were cast locally from simple patterns and fitted with fine feed in both directions, each with cast aluminium adjustable hand wheels. Surface grinding required a second hand wheel to operate the fast table feed while a slide fitted to the table rear disengaged the main drive.

With development now more or less complete,





the design, although fairly experimental, achieves satisfactory results with modest cuts. Final operations include surface grinding, horizontal and vertical milling on a $15\frac{1}{2}$ in. x $5\frac{1}{2}$ in. table with a 9 in. travel ($4\frac{1}{2}$ in. across) and a drilling capacity of $\frac{1}{2}$ in. diameter with $1\frac{1}{4}$ in. travel. The gross weight is 450 lb.



I was fortunate in my final year at Teacher Training College to have the opportunity of building the machine using their equipment and the cost was under £50, mainly due to the extensive use of scrap metal.

Windmills

Sir,—R. G. Selman will find information on the performance of small, horizontal axis windmill rotors in respect entitled "Electric Energy from the Winds" issued as Kansas Engineering Bulletin 52 of the Kansas State College of Agriculture and Applied Science.

This report gives test results on two-bladed 8 ft. diameter rotors having blade widths from 4 - 10 in. Eight different aerofoil sections were tested at various setting angles. The maximum output obtained was 517 watts at a wind speed of 17.2 miles per hour and a rotational speed of 350 revs/min. The output varies as the cube of the wind speed.

The best aerofoil section was found to be one with a flat underside having a thickness/chord ratio of 20 per cent. The best pitch setting angle was 4° but this could not be used with a fixed pitch rotor if the windmill was required to be self-starting at low wind speeds. The above reference, which is obtainable in this country through the public library service, contains much more information on this type of rotor including comparisons between twisted and untwisted blades.

I have seen no information on the performance of vertical axis rotors and should myself be interested if any of your readers know of any.

Leicester. A. S. Lee.

"Derby 4F" A simple locomotive for $3^1/_2$ in. gauge

Part VII **by Don Young** *From page 336*

BUILDERS can now remove their 4-jaw chucks and replace with the faceplate, next bolting an angle plate to it. Cut a $3\frac{3}{4}$ in. length from $\frac{3}{4}$ in. x $\frac{1}{4}$ in. b.m.s. bar and drill two $\frac{1}{4}$ in. holes at roughly $3\frac{3}{8}$ in. centres. All we need to complete our equipment are two $\frac{1}{4}$ BSF bolts 3 in. long, each with nuts and washers.

Apply marking off fluid to the cylinder end face with the bungs adjacent and rescribe the cylinder bores at the finished sizes. Sit the block, port face down, onto the angle plate and hold it there with the strap across the block and the two bolts down into slotted holes in the angle plate. Leave the nuts finger tight for the moment and slide a piece of b.m.s. bar, section say 1 in. x $\frac{3}{8}$ in., between the inner end of the block and the faceplate, then the boring bit will come right through without striking the faceplate a cruel blow. Bring up the tailstock centre and roughly align the block so that the centre coincides with that of one of the cylinder bores. Fit a knife edged tool in the toolpost, bring it up to the block and pull the lathe round by hand to check that it traces the scribed bore line; make any final adjustments necessary.

Drill out the bung before fitting your boring tool to the toolpost; this should be the largest possible you can fit, for preference one with a $\frac{1}{2}$ in. square shank or even larger, for maximum stiffness, and with a detachable bit. Take a heavy roughing cut, to get right under the skin of the casting, using the finest possible automatic feed and when right through, reverse the feed rather than wind the tool out. Carry on and bore out to the scribed circle, the finished size can be a rule dimension. When the final cut is taken, leave the tool at this setting and traverse it backwards and forwards through the bore, using automatic feed all the time, until the tool stops cutting. The swarf will get less and less as you go on until the final smooth bore results. To tackle the second bore, just release the bolts holding the angle plate to the faceplate and move the whole assembly across until you are aligned once more; repeat the dose. We can now move on to the ports.

Accurate positioning of the ports is essential for your engine to perform well, for working at short cut-offs, which the Joy valve gear is admirably suited for, means that a quite minute error can mean the difference of a port opening to steam or not. Having said this the statement requires qualifying, for there is a margin for error in the placing of a group of ports along the valve axis, the important thing to achieve is to get each group of ports, one exhaust and two steam, correct relative to each other; let us proceed.

All the cylinder block faces are now nicely machined so we can use an engineer's square to mark out. Start by applying the now regulation coat of marking off fluid and then scribe on the lines to indicate the width of the ports, working from each bolting face. From the front face, measure 11/16 in. and scribe right across the block, this represents the steam edge of the leading ports. Move back 3/32 in. and scribe another line for the exhaust edge of this port. Carry on and mark out the other ports, using the steam edge of the leading port as your datum for measuring, then dimensional errors are not accumulative.

Scribe on the axial centre line and at 7/16 in. from the front face, centre pop for the No. 41 oil hole. At 1 in. from the front face centre pop again for the exhaust outlet; this outlet is not central along the axis for a very good reason, it makes the blastpipe so much easier to fit later on. We are ready to machine the ports.

Start with the vertical-slide and bolt your angle plate to it, setting horizontal as previously described. Stand the block on the angle plate and pass those two 3 in. long bolts you have by you up through the bores, using a simple strap across the top of the block, which can be the previous one with another couple of holes at the new centres. To get the block perfectly square to the lathe axis, fit the faceplate, wind the carriage along until the port face comes into contact and then tighten down. Before going any further, check that there is sufficient travel available on the vertical-slide to cover at least all the ports for we do not want to change the setting once machining has commenced.

Chuck a No. 48 drill in the 3-jaw and drill a row of holes, as close together as you can get them without breaking into each other, and spelling doom for the drill, in the centre of one of the steam ports. Beginners are advised to drill these holes to 5/16 in. point depth; the finished

port will not look so pretty at the bottom, with the series of drill points still showing, but milling is much easier this way. To ensure the drill does not go too deep and pierce the cylinder bore, a major disaster, make up a little collar, about ¼ in. long from ¼ in. brass rod and fix to the drill with an 8BA screw to act as a drill depth stop.

Leave the vertical-slide at this setting and replace the No. 48 drill with a 1/16 in. end mill; an end mill of this small size is extremely flexible and will cut through gunmetal like butter, so all you have to do is take things nice and slowly, allowing the cutter to do its work without forcing it and just remove the swarf as it fills the cavity. Set the end mill to about ⅛ in. below the port face and take the first cut across, to break through the No. 48 holes and form the beginnings of a slot. Carry on increasing the depth a little at a time until you have a 1/16 in. slot to the full depth of 9/32 in. Come back to the original ⅛ in. depth and begin widening the port to the scribed lines, until you can force a piece of 3/32 in. thick strip into the slot.

Make a note of the vertical-slide micrometer collar readings when the final cuts were taken and deepen the port to 9/32 in., using the same final settings. You now have one complete port, with rounded corners, and this is where beginners can move on, though more experienced builders may wish to produce the square corners as shown, by use of a small cross cut chisel. Move on and cut the other steam port for the same group in identical manner.

For the exhaust port, first drill two No. 10 holes to 9/32 in. depth and roughly open out the port to its full depth with a 3/16 in. end mill, this is much less nerve-racking than using the smaller size. Revert to the 1/16 in. end mill and first finish the sides to the full ½ in. width; we must now concentrate on the working edges of this port.

Start by cleaning up one of the edges to a nice straight line to the full depth of 9/32in. Fit the check piece of 3/32 in. strip into the adjacent steam port, place an odd length of say ⅜ in. x ⅛ in. strip against the face just machined and force hard into place. You can either do this with pieces of packing, or use a short 4 BA bolt and nut, opening up to trap the strip in position. Now all you have to do to measure the exact width of the port bar between the steam and exhaust ports is simply use a set of feeler gauges in the gap. Subtract .094 in. from the reading obtained and you know exactly how much more metal to remove. Set the vertical-slide collar by this amount and mill to size; repeat for the other edge of the exhaust port. By this method the exhaust port will probably not work out at precisely the ⅜ in. specified; to correct the valve later all we have to do is push pieces of 3/32 in. strip into each steam port, measure over them with a micrometer and compare the result with the ¾ in. nominal figure. Now you see there was a little bit of 'kidology' by yours truly at the outset of machining the ports, for the reason that they are so important.

Carry on and complete the second group of ports, which more experienced builders will have done at the same settings and at the same time as the first group, but for beginners it is best to concentrate on one port at a time.

At the exhaust outlet, drill 11/32in. dia. to 9/16 in. depth, to achieve this it is best to drill say No. 30 initially and gradually open out to size. Grip a ⅜ in. x 32T taper tap in the 3-jaw, pull the chuck round by hand whilst feeding the block onto the tap. When the tap 'bottoms' there should be 9/32 in. of full thread, if not use a plug tap to complete. To complete this phase of the operation, drill right through the block at No. 41 for the oil supply passage. Turn the block through 180 deg. and face the area around the No. 41 hole with either a ⅜ in. 'D' bit or end mill. Drill No. 11 into the No. 41 hole for about ¼ in. depth, tap 7/32 in. x 40T as for the exhaust outlet and we have our oil delivery clack connection.

There is one more major task to complete before we lay the block aside, the steam and exhaust passages. Starting with the latter, centre pop in the inner corner of each exhaust port, a full ⅛ in. from the front edge. Drill No. 30, angled at approx 45 deg., into the exhaust outlet hole. Open out gradually to the finished size of 7/32 in. dia; for this operation I find it better to use a carpenter's brace, rather than the hand drill, it gives better control as rotation is at a much lower speed. Be careful not to touch the finished front edge of the port, or you will have destroyed all the good work that went before.

For the steam passages, start by filing a small flat at the entrance to each bore, at the positions of the drilled hole dimensions for the passages, then centre pop each passage as shown. There are many ways of drilling passages, setting up on blocks for machine drilling, etc., but I reckon it is just as quick to drill them by hand. Grip the block in the bench vice, using soft clams to prevent damage to those precious machined faces, and set over at about 20 deg. The angle is correct when the block is angled by ¾ in. over its 2⅛ in. length and this is easy to check by using a square on the vice jaws and measuring at the top of the block. Then all you have to do is drill

vertically down from the end of the block to the steam port. First drill No. 41 and see where the drill breaks into the port, there is a fair margin for error, but try not to get the hole too close to the port face itself. If the drill breaks through close to the bottom of the port all is well; poke a length of 3/32 in. rod in the hole, about 2 in. long, and use as a sighting aid for drilling the first passage for the other cylinder bore. Swop the sighting rod over and use to drill the second passage for the first bore and then back again to complete this end of the block; repeat at the other end and open out to No. 24.

If your first drilled hole wanders from the straight and narrow, this is not difficult to correct. Start a No. 30 drill in the No. 41 hole, but only to about 1/16 in. depth. Chuck an $\frac{1}{8}$ in. end mill in your hand drill, not the carpenter's brace for these passages, and alter the drilling angle in the required direction. The end mill will not try to follow the No. 41 hole, but will seek out a new path. In this way you can produce an $\frac{1}{8}$ in. hole to about $\frac{1}{2}$ in. depth, the limit of the end mill shank. Follow up with a No. 30 drill, right through to the port and use an $\frac{1}{8}$ in. sighting rod. Lay the block aside and we can tackle the steamchest.

Reminiscences

Little did yours truly realise when penning those reminiscences on Doncaster Plant Works the pleasant consequences there would be, for the original purpose was merely to provide some sort of background to my humble designs and writings in *Model Engineer*. The whole subject was dealt with rather tongue in cheek, as the conviction that "M.E." is a constructional magazine was paramount and those articles certainly did not set out to show readers how to build a lovely Gresley A.3 "Pacific", though they may well have precipitated this for the future.

That the series was well received remains a mystery, but the articles were instrumental in gaining new friends, from among model engineers and railwaymen; they also opened a few doors. As the years pass I shall be able to recall more happenings of time served on British Railways, and later when I was only an interested spectator, for those concerned have now reached retirement. This I hope to do in the months ahead, in these pages, as space permits.

One section that showed particular interest in reminiscences of The Plant was the band of ex-premium apprentices whose ranks I (literally!) swelled. Among these I would single out Eric Beavor at this time, for Eric has briefly told his story in *Steam was my Calling* which was published a few months back. From this interesting book has stemmed a clamour for more words on two subjects covered, namely Doncaster Plant Works and Motive Power Depots.

Eric was a premium apprentice for the last five halcyon years of Gresley's glorious reign and subsequently served in the Drawing Office, whilst yours truly was "signed up" by A. H. Peppercorn in 1948 and finally parted company with The Plant in 1956. Between us we cover about 20 years out of a total of over 120 years since Doncaster Plant Works came to life, so there are plenty of gaps and it is these that Eric is hoping that readers of *Model Engineer* can help to fill in. He will be grateful for the loan of photographs, documents, reminiscences and anecdotes on The Plant, the same also for motive power depots. For the latter subject photographs of life "on shed" are of particular value, the scope being worldwide, and although the prime interest is in depot facilities this does not preclude the locomotives themselves, or the men that serviced them.

Knowing the flood of correspondence that my own humble articles generated, please direct the tidal wave to Lindenstrasse 33/9, CH-4102, Binningen, Switzerland, for Eric to deal with direct; thank you. I trust that our Editor will allow this brief appeal, knowing that he is a staunch Gresley supporter, though he has confessed that had his upbringing been in the West instead of North London his first love would probably have been the products of Swindon; there is no answer to that statement!

Cylinders (cont.)

Derby supporters can rest content that a very comprehensive account of their Locomotive Works has already been published, so on we go with our 4F cylinders, for which the steam-chest is a gunmetal casting and relatively simple to machine. Start by measuring up the casting, to assess machining allowances, noting that more metal has to be removed from the top bolting face to bring the valve spindle bosses to the position shown.

Rub a file over the bottom bolting face, to bring it reasonably flat, then fit in the 4-jaw with this cleaned face against the chuck body. With a round nose tool, machine down the top bolting face to the valve spindle bosses, taking light cuts to prevent a "dig in" at any of the corners. Reverse in the chuck and finish to the correct overall thickness of $\frac{1}{2}$ in. Turn the casting round to bring one of the faces which fits between the frames towards the tool and machine approx. 1/32 in. from this face; this is what the machining allowance shows from my sample casting from the Reeves emporium. Reverse in the chuck and face

off to the required overall width of 2⅞ in., checking against your frame gauge.

There are four bosses on the casting, we need the longest pair for the valve spindle bosses, so from the already machined faces mark off the valve spindle centres and pop deeply. Chuck in the 4-jaw, by one of the redundant bosses that now becomes a chucking piece, and set so that a pop mark is running true. Centre and bring the tailstock into use to turn down the boss to ⅜ in. dia., setting the tool over to miss the other boss. This operation may be omitted if desired, but you must face off the boss to ½ in. length and then drill No. 23 into the steam-chest, following up with a 7/32 in. "D" bit to ½ in. depth. Tap ¼ in. x 40T and then run a 5/32 in. reamer through the remains of the No. 23 hole; repeat for the second valve spindle.

Clean up this back face of the steam-chest with files, it is not worth trying to machine it as your tool will undoubtably foul the bosses. Cut off the two bosses, used as chucking pieces, from the front face. This latter face can be milled to size if you like, by bolting to an angle plate attached to the vertical-slide, although it is far easier to remove the 1/32 in. or so required with files. This is a good filing exercise, checking against the machined faces with your square, for if the finished face is in error it matters not.

Next, clean up the inside of the steam-chest with files, there is very little metal to be removed, and then mark out for the seventeen fixing holes. Tackle these in either the drilling machine, or the lathe, either will do as long as the holes are square with the bolting face, and use a No. 30 drill initially. Offer the steam-chest up to the cylinder block, clamp tightly together and check with the frame gauge that the steam-chest is not overlapping the sides of the block. Spot through the No. 30 holes, remove the steam-chest, drill the block No. 40 to 7/32 in. depth and tap 5BA.

For the steam-chest cover, cut a piece 2⅞ in. x 2⅛ in. from 3 mm. or 10 s.w.g. brass sheet. Clamp to the steam-chest and drill through the No. 30 holes, next mark off and drill the ⅜ in. hole for the exhaust fitting and finally tackle the ⅜ in. x 32T hole for the steam connection.

Looking back at the sectional assembly drawing of the cylinders you will see that the steam-chest and cover are secured to the block via studs. These latter are 1 in. lengths of ⅛ in. stainless steel rod, screwed for 3/16 in. length at 5BA at each end, save for four which have an extra ¼ in. of thread at the upper end. The reason for these four longer threaded studs is simple; to set the valves later on one has to remove the steam-chest cover, yet the steam-chest itself must still be rigidly held in position. So if you fit one of these studs in each corner, the nuts can be run down to secure the steam-chest; simple!

To insert studs in the block first enter by a few threads and then fit two 5BA brass nuts; tighten together and then screw the stud into the block, by use of a spanner on the upper nut. When tight, transfer the spanner to the bottom nut and continue tightening, this will unlock the pair of nuts. This process causes heavy wear to the nuts and they must be discarded, not used to secure the steam-chest cover.

After fitting all the studs, it will be found impossible to slip the steam-chest over them, or such has been my experience. Where a stud is leaning over at a drunken angle, the easiest way to sober it up is to take a 4 in. length of ¼ in. steel rod, drilled No. 30 to about 1 in. depth, fit it over the stud and apply a little hand pressure. To make the whole thing a lot easier just open out the holes in both steam-chest and cover to No. 29, slide home and secure for the moment with a few 5BA brass nuts.

The cylinder covers come next in line for attention and as the front ones are much less critical, these can be the means of acquiring the little amount of skill required. These covers are neat gunmetal castings, complete with chucking pieces; grip a front cover in the 3-jaw chuck, by its periphery, and clean up said chucking spigot. Reverse in the chuck and face across, before turning down the outside to 1⅝ in. diameter; now we have to turn the spigot to suit the bore. To achieve this we need the ordinary R. H. bar turning tool, set over slightly so that neither cutting edge rubs against the machined surfaces. First turn the spigot to about 1 5/32 in. diameter and 1/32 in. high, then carry on with minute cuts until the spigot is a tight fit in the selected cylinder bore. It does not matter at all if the result is a "rattling" fit for the front covers, but the fit is important for the back ones, so try to get the correct fit as practice for later on.

With a knife-edged tool fitted, direct the pointed end towards the chuck, set to just touch the cover and turn by hand to trace out the pitch circle of the eight fixing screws. Check the diameter with a rule, correct as necessary and then produce a slightly deeper circle, again pulling round by hand, the centre pop will drop quite happily into this groove when you come to position the holes. Pull the job out of the chuck just sufficiently that a L.H. bar turning tool fits between the jaws and the back of the cover; face off then saw off the chucking piece and clean up with a file.

Offer this cover up to the block and cut away the excess metal projecting beyond the outside of the block.

To be continued

MAKING SMALL LIVE STEAM INJECTORS

by D. E. Lawrence

History

THE INJECTOR was the invention of a Frenchman, Henri Giffard, in the 1850's. Giffard's interest was aeronautics and the steam engine was then the only means of power propulsion available to him in his experiments of powered flight. Boiler feed pumps were very heavy and he wanted some lightweight means of supplying water to a boiler and so his injector was born. The early versions were unreliable and required careful regulation to make them work. Also, because the way in which they functioned was not obvious, Giffard's invention was slow in being adopted; in fact, people were downright sceptical about the things. Subsequent modifications by himself and others brought the injector to a high standard of reliability, Fig. 1. Its widest use is (or rather was) in the field of locomotives, but it has been used as a standby feed for stationary and marine power plants.

In the realm of model locomotives, I have little knowledge of injectors in the early years of the hobby — they were around long before I was born! As long ago as the 1920's and probably earlier, there were a few injectors on the market. But in the 1930's I remember hearing about the *Vic* pattern and the *Cert* injectors, Figs. 2, 3, though I cannot say that what I heard about them was complimentary. The late LBSC described a *Vic* type of injector in his first book *Shops Shed and Road,* which was re-named the *Live Steam Book* in later editions. Over the years, LBSC, whose injectors were usually called *Curly* injectors after his nickname, modified his designs and his later injectors attracted less blasphemy than the early ones.

I only ever made two *Curly* injectors which worked at all out of about a dozen. Most people to whom I talked about them had the same experience, that is, when the things worked, they required the most careful regulation of steam and water. This regulation is acceptable on an up-and-down track where topping up the boiler can be done between runs. But on a continuous club track, the headway between trains is often so limited that prolonged attention to regulating an injector often means that one cannot keep a good look-out ahead and that can mean disaster! As a consequence an injector which can be turned on in the certainty that it will "pick up" first time and need only a quick look to ensure all is well, is a highly desirable thing to have.

In the early 1930's two live steam enthusiasts turned their attention to the injector problem. They were Mr. C. M. Keiller and Mr. E. J. Linden; both obtained satisfactory injector pro-

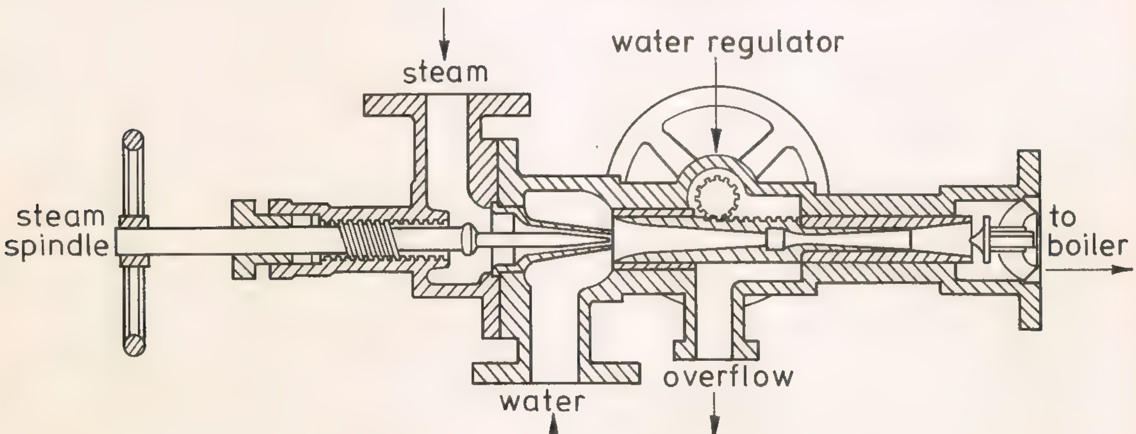


Fig 1. GRESHAM'S IMPROVED GIFFARD INJECTOR
CIRCA 1860

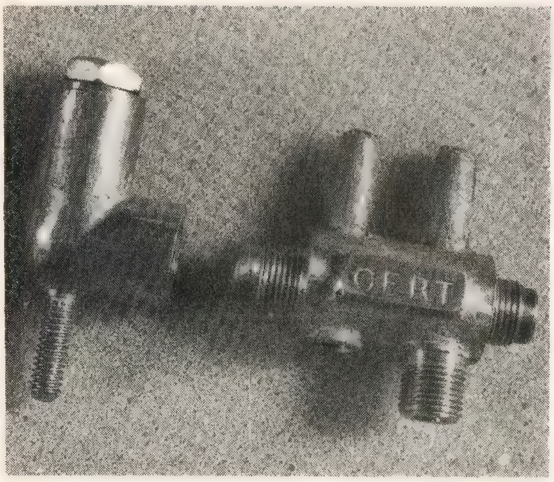


Fig. 2 "Cert" injector body and elbow clack, part machined (Bill Carter's collection).

portions and Mr. Keiller went on to experiment with "high" pressure boilers and, incidentally, find injector proportions to feed at the increased pressures he was using. Ted Linden found there was a market for reliable small injectors and produced his own injectors commercially. The *Linden* injector was eminently satisfactory, but its pre-war price of thirty shillings was not a great inducement for many of the faithful to buy and perhaps it was not as widely known as it could have been. I came to know Ted Linden fairly well and found him extremely reticent about his injectors—he was a clam on the subject, in fact. The so-called "secret" of his injectors died with him. Actually, there is no secret as such, the essential ingredients of a reliable injector are *good* proportions and *care* in manufacture and assembly.

Fig. 3: Cut-away section of "Cert" injector (Bill Carter's collection).

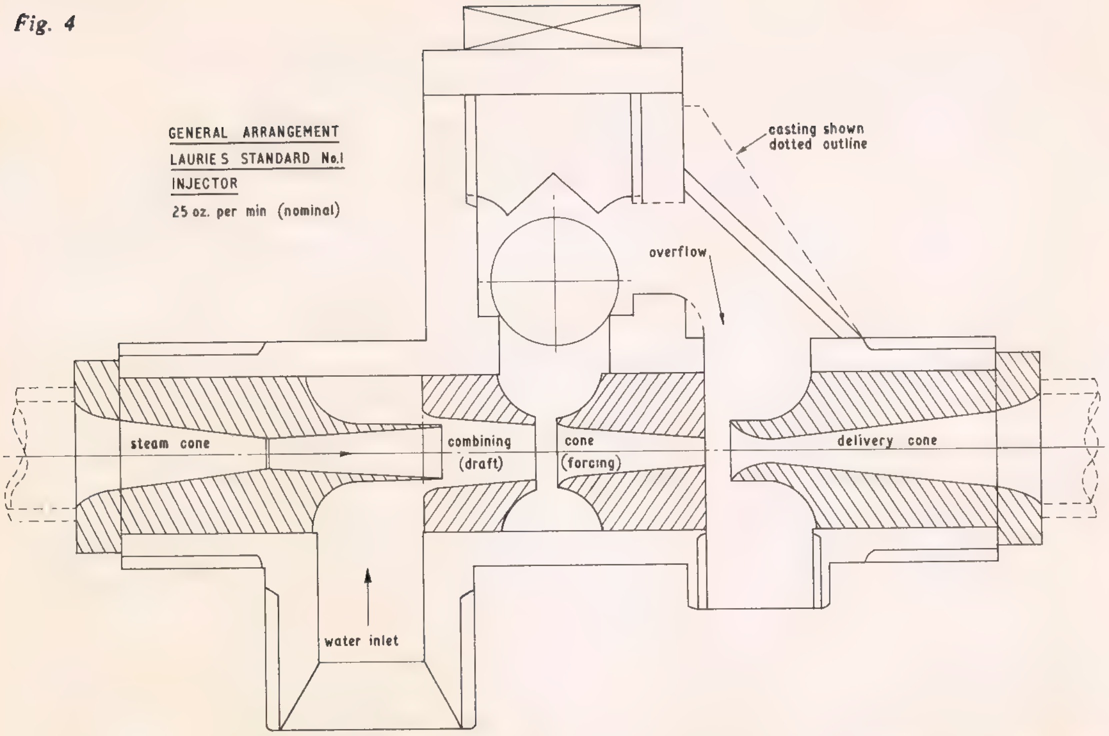
I had several conversations with the late C. M. Keiller who was very helpful and also with a former GWR chief draughtsman who gave me several pointers as to good proportions and a few wrinkles as well. He was also kind enough to suggest some literature on the subject. Getting the literature proved rather daunting and I was very largely helped by a member of the staff of my local library. She treated the whole matter as a challenge to their slogan "if it's printed, we can get it" and she did! Incidentally, an interesting historical note—the very reliable GWR injectors were adopted as standard for British Railways on nationalisation. It seems that even then the other railways had injector problems.

To return to the model world; my own experiments into getting a reliable injector began back in 1955 following a bump from behind by another train, the driver of which had been absorbed in trying to get his censored injector to work. *Linden* injectors were still comparatively expensive and the cheapness of the home produced article was an undoubted spur to my modest ambition. I achieved the small success with the *Curly* injectors which I mentioned earlier. This was sufficiently encouraging for me to write an article (M.E. 17-11-55 page 740) in the mistaken impression that the penny had at last dropped for me — oh dear me, how wrong I was!!

Published information

Literature on the subject is sparse and was so even before the steam locomotive was discarded in this country. Whatever had been written about injectors was "ancient history"; there was no text book later than 1910. The earliest book I found was by an American Professor who had the resounding name of Strickland Landis Kneass and his book was published in 1898. I was intrigued to find it ran into three editions. Another weighty work which appeared about the same time was by W. W. F. Pullen, who bewailed the fact that nobody knew what they were doing in the U.S.A. There were other publications such as one by the Locomotive Publishing Co. in 1905, intended for a lower level of understanding than the Professor's works. Also the manufacturers of full-size injectors usually issued small handbooks-cum-catalogues which gave some simplified theory and useful data as well as describing their products. The writers gave a chapter or two on theory and then followed up with several chapters describing the products of the various manufacturers. *Terrell-Croft's Steam Plant Auxiliaries* had

Fig. 4



a useful chapter devoted to injectors. There were a number of papers in the journals of learned Institutions to which I had no access. After that the words and music dried up.

In model engineering, only the late LBSC's instructions covered the subject at the time I began experimenting.

The notes which follow are the result of about 5 or 6 years of sporadic spare time work and I had intended to submit them to *Model Engineer* for publication some years ago, but articles appeared in the S.M. & E.E. Journal in 1962 and 1963 on the subject and it seemed to me at the time that my contribution would have been superfluous. There was an added deterrent in that the then Editor of "M.E." (NOT the present enlightened incumbent of that office) was rather unreceptive and pre-occupied with a non-model engineering policy. So my notes were shelved. However, from discussions during my travels round the country, from correspondents and from my experience of the LBSC Memorial Bowl Competition, it seems there are still many model locomotive enthusiasts who have trouble in making decent injectors, so I am persuaded that this article may prove of some value to my fellow live steamers.

The instructions given may appear over-detailed in many respects, but I make no apologies for this. During my experiments I made quite a few injectors and I tape-recorded what I was doing as I did it for each succeeding "recipe". When success came, I played back the instructions to myself to make a few more. The tapes were subsequently transcribed, the many expletives blue-pencilled and I added a description of a suitable water valve and captive steam valve. I have done some revision because it is many years since the construction notes were written and I have also pruned them in places. Early in 1974, Bill Carter got bitten with the injector bug —he wanted some spares for his famous Atlantic —and he discussed the subject with me. Arising out of this, Bill made several injectors, some to my "standard" design and some to his own based on the Keiller proportions. All of them with built up bodies. Bill made some suggestions and I have been very pleased to include these. Bill's own injectors were made with $\frac{3}{8}$ in. dia. bodies and he needed a little persuasion to retain the 5/16 in. dia. for my design. However, he did so, and agrees that it makes for a neater injector.

Bill has an injector test rig and we had a couple of highly enjoyable sessions putting the injectors he had made and one of my own through their paces. As Bill has actually made *Laurie's Standard No.* 1 *and* 1*A* as he calls them, (I might add with his usual impeccable workman-

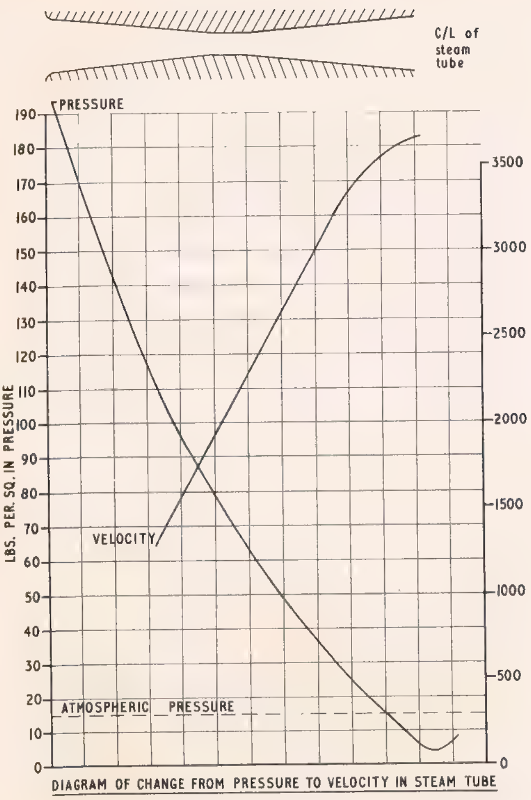


Fig. 5

ship), and as they tested OK you can be sure of good results. Bill has kindly agreed to give instructions for making his testing valve which allows an injector to be tested whilst delivering against boiler pressure, but the feed water to go to waste instead of filling the boiler. This saves frequent blowing down of the boiler and gives better control of the pressure range over which an injector is tested.

In addition to Bill Carter's generous and extensive co-operation, I thought it reasonable to try out these instructions on a couple of "guinea pigs" first before publication. I am not used to writing "do this, do that" articles and I wanted to make sure that the instructions were clear and could be followed by model engineers of varied skill. Derek Pring and Bertie Green allowed themselves to be persuaded to act as guinea pigs. Also Ken Cribb modified the casing (or body) of a redundant commercial injector to my instructions and Bill kindly made and fitted *Standard No.* 1 cones in it. I am indebted to Bertie and Derek for their most useful co-operation and for comments and suggestions as to where clarification was needed in these instructions. Odd how one takes things for granted; I thought my notes were complete, yet still holes appeared! Lessons learned from their experience in following these notes are in the section entitled *Inquest*, which also includes test results of the injectors.

So that readers can understand the need for the various parts of an injector, it would be best if I explained, in my usual lightweight fashion, what they are and their purpose. The injector consists of five basic parts: The body or casing; The steam cone; The combining cone; The delivery cone; The overflow with non-return valve in the body. In American parlance the cones are often called tubes. In the type of injector described here, the combining cone is in two parts — the draught tube and forcing tube; the latter is sometimes referred to as the combining cone only. The function of the steam cone is to accelerate the steam to an extremely high velocity; in the convergent part of the tube the steam accelerates in the gradually decreasing section in which it is flowing; in the divergent part of the tube, steam is allowed to expand and lose some heat and its pressure and gain further great velocity. Those familiar with the de Laval nozzle will know how this comes about. The acceleration of the steam is of a high order and the steam reaches a speed of over 2,000 m.p.h. and the pressure at the steam cone exit is, or should be, well below atmospheric. The graph at Fig. 5 based on one given in an old Gresham & Craven handbook (to whom due acknowledgements are made), shows the interchange of pressure into kinetic energy (velocity) along the tube.

In an injector arranged to lift, i.e., lift water from a level lower than that of the injector, steam must escape very freely via the overflow, which should be large, to produce a partial vacuum in the water chamber and exhaust air from the pipe and thus suck water up into the injector. It should be noted that the exit of the steam tube should be of similar size or smaller than the exit of the draft tube for an effective lift. When water reaches the draft tube things get a bit complicated; the high velocity steam particles impinge on the slowly flowing water and they impart kinetic energy to the water, which then moves faster. The steam cone has to be properly shaped for the steam to act effectively on the water. Fig. 6, A and B, show the shapes of the emerging jets of steam from a plain orifice and a divergent orifice (with acknowledgements to Messrs. Gresham & Craven). That of Fig. 6 A, was originally used by Giffard in his injectors and was a major cause of unreliability and the need for careful regulation.

(Figs. 6 and 6A will appear in the next instalment. — Ed.)

CLUB NEWS

News from Guildford
At a recent Bits & Pieces evening, Alan Jensen exhibited the frames for his *Torquay Manor*, Mr. Knee showed the remaining items for a Dore-Westbury vertical milling machine, Geoff Moore has made further progress on the smokebox of his *Springbok*, and Bob McMillan showed the partly finished frames for another *Springbok*. Bob Wiggins has started work on a *Maisie* boiler, Mr. Yeo is building a Quorn tool and cutter grinder and a new member, Mr. Oates, has almost completed a model caravan. He is shortly to tackle a farm elevator.

The Guildford M.E.S. are holding their popular Model Traction Engine Rally and Model Engineering Display on July 19th-20th.
Secretary:— Mr. Charles Webster, 49 The Oval, Wood Street, Guildford, Surrey.

Melbourne (Australia) S.M.E.E.
I was sorry to hear of the death recently of Mr. Norman A. Coventry, one of the founder members of the Melbourne Society and its first Secretary.

This Society now has approximately 75 members, and meetings are held on the second Friday of each month at 92 Wills Street, Glen Iris. Visitors will be most welcome.
Secretary:— K. Constable, 84 Cityview Road, North Balwyn, C Victoria 3104.

New members at Rochdale
I hear that the Rochdale S.M.E.E. now has no less than 100 members. Meetings are now held at the Rochdale College, Room B.104.
Secretary:— Mr. W. Porter, 21 Moreton Street, Chadderton, Oldham, Lancs.

Isle of Wight
The Isle of Wight M.E.S. celebrated its 40th year of model engineering in 1974 and this year membership has reached the respectable total of 100 members and the Society has its own site at Broadfields, Cowes, a 800 ft. three-gauge continuous track, and a boating lake of some 2000 sq. ft.
Secretary:— Mr. N. J. Gawler, 44 Church Road, Gurnard, I.O.W.

Facilities at Crewe
The Crewe M.E.S. meets at the club room at 29 Mill Street, Crewe on Wednesday and Thursday evenings and Sunday afternoons. A $3\frac{1}{2}$ in./5 in. track is being built at the Recreation Ground, Beech Drive, Wistaston.
Secretary:— R. A. Hawkesford, 455 Newcastle Road, Shavington, Near Crewe.

Calling Middlesbrough-Saltburn area
David Reyer, the new Secretary of the Middlesbrough Model Locomotive Society would be delighted to hear from model engineers in this North-East Yorks area. His address is 61 The High Street, Skelton-in-Cleveland, Saltburn, Yorks.

CLUB DIARY

Dates should be sent five weeks before the event. Please state venue and time.

April 18 Stockport & District S.M.E. Talk by Mr. G. W. Richards on the Rudiments of Electrical Installation. Wellington House, Wellington Road North, Stockport. 8 p.m.
April 18 Romford M.E.C. "Tuppence all the Way" — Mr. Leahy. Ardleigh House Community Centre, 42 Ardleigh Green Road, Hornchurch, Essex. 8 p.m.
April 18 Rochdale S.M.E.E. Spark Machining — F. A. J. Collin. Technical College. 7.30 p.m.
April 18 East Sussex Model Engineers. "Windmills" illustrated talk by Barry Funnell. Mercatoria Hall, St. Leonards. 7.45 p.m.
April 18, 19 & 20 Worthing & District S.M.E. Exhibition. Lyndhurst Leisure Centre, Lyndhurst Road, Worthing. Friday, 12 noon-9 p.m. Saturday, 10 a.m. 9 p.m. Sunday, 10 a.m.-6 p.m.
April 19 Guildford M.E.S. Visit to SMLS at Beechurst, Haywards Heath.
April 19 Peterborough S.M.E. Exhibition in The Brook Street Adult Institute, opening 10 a.m.
April 19 SMEE. Rummage Sale. Marshall House, 28 Wanless Road, SE24. p.m.
April 20 Northampton S.M.E. Boiler test day at Delapre Park from 10 a.m.
April 20 Worcester & District S.M.E. Public Running Day $3\frac{1}{2}$in. – 5in. + $7\frac{1}{4}$in. gauges. Waverley Street, Diglis, Worcester. 11 a.m.-6 p.m.
April 20 Gauge "1" Model Railway Association. B.R. "Open Day" (Portable track). Eastleigh Works.
April 20 Peterborough S.M.E. Public Running Day at the Club Track. Previous visitors are most welcome. Commencing 10 a.m.
April 21 Wigan & District M.E.S. Meeting. Co-op Guild Room, Whelley, Wigan. 7.15 p.m.
April 21 City of Leeds S.M.E.E. Templenewsam — Informal meeting.
April 22 Sutton Coldfield & North Birmingham M.E.S. A.G.M. Co-Operative Meeting Room, 286 Brookvale Road, Erdington, Birmingham. 7.30 p.m. for 8 p.m.
April 22 Romney Marsh M.E.S. A.G.M. Church Hall, New Romney. 7.30 p.m.
April 23 Sutton Coldfield Railway Society. Layout and Chit Chat. Wylde Green Library, Emscote Drive, Little Green Lanes, off Birmingham Road, Sutton Coldfield. 7.30 for 8.15 p.m.
April 23 Cannock Chase M.E.S. Open Evening. Lea Hall Colliery Social Club, Sandy Lane, Rugby.
April 23 Southampton & District S.M.E. General Meeting – "President Evening".
April 24 Leyland, Preston & District S.M.E. Meeting. Roebuck Hotel, Leyland, Lancs. 8 p.m.
April 24 Hull S.M.E. Basic Electronics by G. Davison. Trades & Labour Club, Beverley Road, Hull (Room 3). 7.45 p.m.
April 25 Institution of General Technician Engineers. Ordinary Meeting. Paper: "The Crossing of the Alps by Rail" F. J. G. Hout, F.R.S.A., B.Sc. (Eng.), C.Eng., M.I.Mech.E. Lecture Hall, 33 Ovington Square, London SW3. 7 p.m.
April 25 Dublin S.M.E.E. "Allchin traction engine" by Mr. G. Drumm. City Quay School. 8 p.m.
April 26 Northampton S.M.E. Portable track will be running at "The College of Further Education" Booth Lane, Northampton in conjunction with a M.E. Exhibition put on by the Education Authority.
April 26 Colchester S.M.E.E. Models Night. Clubhouse, Old Allotments, Lexden, Colchester. 7.30 p.m.
April 26 & 27 Bedford M.E.S. Public Exhibition. Corn Exchange, Bedford, Saturday, 10 a.m. to 7 p.m. Sunday, 10 a.m. to 6 p.m.
April 27 Harlington Locomotive Society. Open Day. Harlington Locomotive Society. High Street, Harlington, Middlesex. 2 p.m.-6 p.m.
April 28 Clyde Shiplovers & Model Makers Society. A.G.M. Partick Halls, Burgh Hall Street. 7.30 p.m.
April 28 Peterborough S.M.E. Visit to a local Power Station. Details of time and place will be announced nearer the date.
April 28 Stafford & District M.E.S. Film Show by Mr. D. Bradbury. Riverside Centre, Stafford. 7.30 p.m.
April 28 North Wales M.E.S. Meeting. Penrhyn New Hall, Penrhyn Bay, Llandudno. 7.30 p.m.
April 30 Guildford M.E.S. Beer and bangers evening at the Fox Hotel, Bisley. 7.30 p.m.
April 30 Sutton Coldfield Railway Society. Steam Cine (Frank Hemming). Wylde Green Library, Emscote Drive, Little Green Lanes, off Birmingham Road, Sutton Coldfield. 7.30 for 8.15 p.m.
May 1 Gauge "1" Model Railway Association. M.R.C. Track Night. Keen House, Calshot Street, Kings Cross, London N1. 6.30 p.m.
May 2 Romford M.E.C. Competition Night. Ardleigh House Community Centre, 42 Ardleigh Green Road, Hornchurch, Essex. 8 p.m.
May 2 Lincoln M.E.S. Club Meeting. Unitarian Chapel, High Street, Lincoln.
May 2 Stockport & District S.M.E. Bits and Pieces. Wellington House, Wellington Road, North, Stockport. 8 p.m.
May 2 East Sussex Model Engineers. Talk on boilers by Martin Evans of "Model Engineer". Mercatoria. 7.45 p.m.
May 2 Rochdale S.M.E.E. Track Making — G. A. Eveniss. Technical College. 7.30 p.m.
May 2 Birmingham S.M.E. Annual dinner and dance at the George Hotel.
May 3 Ickenham & District S.M.E. Public Running (Fare paying passengers). Rear of Coach and Horses, Ickenham. 2 p.m.-6 p.m.
May 3 SMEE. Headquarters Clean-up. Marshall House, 28 Wanless Road, SE24. 2.45 p.m.

The Editor welcomes letters for these columns. He will give a Book Voucher for £3.00 for the letter which, in his opinion, is the most interesting published each month. Pictures, especially of models, are also welcomed. Letters may be condensed or edited.

Hipp Clock

SIR,—The article by Mr. John Stevens on modifications to a Jones "Hipp" clock, M.E. No. 3507 was of particular interest to me, as I also made a clock to the same design about twenty-four years ago and experienced the same trouble with the vane pivot.

Shortly after the clock was completed, I carried out a modification similar to that described by Mr. Stevens, and fitted the vane with a hardened silver steel staff having conical pivots, which work in hollow cone bearings of the type commonly used in the balance of 30 hour clocks. This arrangement gives an exceptionally free vane which is not adversely affected by oil.

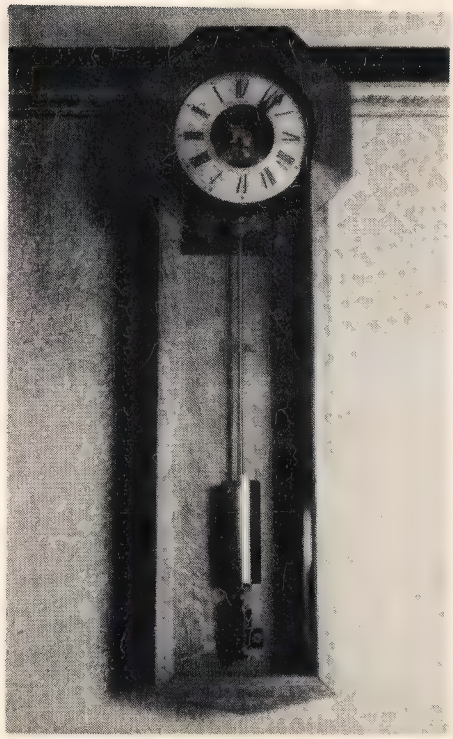
The clicks, bangs and sundry unwelcome noises, mentioned by Mr. Stevens, are caused by the vane coming to rest on the top edge of the notch, and then slipping off as pressure is applied on the return swing of the pendulum. The chance of two knife edges coming together in this fashion would appear to be very slim indeed, but with each stroke of a heavy pendulum between impulses, the variation of arc, at the point where the vane is attached to the rod, is minute, and sooner or later, the two edges coincide precisely. I should imagine it would be less likely to happen—other things being equal—in a smaller clock having a lighter pendulum, and, consequently, greater variation of arc, as in the table clock, referred to by Mr. Stevens.

Modifying the vane pivot and ensuring that the edges of the vane and notch were honed sharp and in true alignment eliminated this trouble to a great extent, but it was not until fairly recently that I discovered the real solution to this irritating fault—quite by chance.

About six years ago, I decided to try a pair of tungsten contact points; those originally fitted were of silver alloy which tended to get dirty, and occasionally caused the clock to stop. The tungston points are ideal, and have never needed cleaning from that day to this. However, that is by the way, the remarkable thing was, that from then on, the vane actions were perfect, and two or three years passed by without so much as a single click.

Obviously over such a period of time it would not be dismissed as mere coincidence, so one day I decided to investigate, and with the case front removed, carefully examined the contact mechanism whilst the clock was still going.

In this particular design, the contact arm is fixed to a flat spring at one end—mine is a piece of feeler gauge blade—and rests against an adjustable stop at the other. I noticed that this stop was just clear



Mr. Broughton's "Hipp" clock.

of the arm, apparently I had moved it when fitting the new points, and forgotten to reset it afterwards. At first this did not seem to be of any particular significance, as the spring was holding the arm in the correct position, despite the fact that it was not touching the stop. However, on taking a closer look with the aid of an eyeglass I could see that the contact arm was being maintained in a state of continual vibration by the action of the vane wiping over the clock. It was so slight as to be unnoticeable to the naked eye, and of course, could not have occurred if the stop had been in position.

Here then, was the solution; given true alignment, it is virtually impossible for a freely pivoted vane to rest on the edge of a vibrating block. It is bound to fall cleanly in or out of the notch. This fact has been well demonstrated by my own clock, which for the past six years has worked perfectly without any attention other than replacing the battery on average every two years.

With a little experimenting, it should not be difficult to contrive this effect in any of the various designs of "Hipp" contact gear. Probably in some cases it could be best achieved by mounting the block on a separate light spring attached to the contact arm, with a stop located a few thou. underneath it to transmit pressure to the arm when contact occurs.

Barnetby, Lincs. D. W. Broughton

Turning oval glands

SIR,—On reading the article by "Tubal Cain", February, 7th, I was amused by the way in which he opted out of prescribing a machining set-up for

the 'oval' of the piston-rod gland. This was of particular interest to me, since I was currently tackling a similar job with the glands and pipe flanges of a Stuart launch engine.

If the illustration of the gland on Page 125 is studied carefully it will be seen that the oval is made up of two flanks which are circular arcs, 1 1/16 in. radius and two semicircular ends with a specified radius of 3/16 in. In my copy of the M.E., on the vertical centre line of the gland drawing, between the dimensions "120°" and "7/16" ø" there appears a tiny speck which proves to be the centre of one of the 1 1/16 in. radius arcs.

The method which I have satisfyingly adopted to produce these 'ovals' is as follows, the dimensions being adapted to suit the Stuart No. 9 gland:— Do not finish-turn the outer face of the gland until the 'ovalising' has been completed. Before drilling the stud holes, lightly scribe two lines transversely across the gland face through the centre marks for the stud holes. These scribed lines are the bases of the two end semi-circles.

Obtain a scrap of aluminium alloy bar of, say ½ in. x 1½ in. section and about 3 in. length. Scribe in the longitudinal centre line and scribe a cross line perpendicular to this ¾ in. from the mid-point of the bar. Centre-pop the mid-point. Set the dividers to 7/16 in. and with the intersection of the two scribed lines as centre, mark out for two 5BA tapped holes at 7/8 in. centres on the cross line. Drill and tap these holes and also a ½ in. (nominal) hole at the intersection of the scribed lines. This latter should be a push fit for the gland boss.

You now have a dummy cylinder cover, to which the part-machined gland should be bolted.

Set the dividers to 1 1/16 in. and with one leg of the dividers at the mid-point of the bar, check that it gives a satisfactory curve when swept over the gland, adjusting the radius and/or centre point if necessary.

Remove the gland from the bar, turn it through 180° and bolt it down again. Try the dividers again over the second flank. Finalise your choice of radius and centre point (which *must* be on the centre line of the bar) and mark or centre-pop this final centre point clearly. Scribe the arc on the gland.

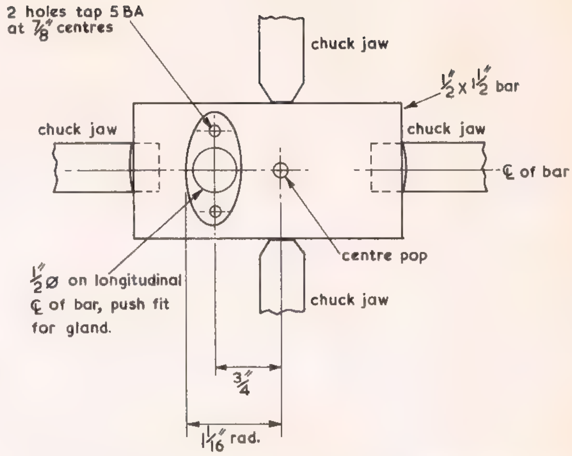
Chuck the bar in the four-jaw so that the centre point runs truly and the face is also true. With a knife tool, light cuts and a speed of, say, 90 rev/min proceed to turn the 'oval' flank until the scribed line is reached. Note the reading on the cross-slide feed collar. Leaving the bar undisturbed in the chuck, remove the gland, rotate it and proceed after bolting down firmly to 'turn the other cheek'.

You should now have two nice shiny flanks on the oval. Next, mark the bolt hole centre lines on the freshly-turned edges, using paint, tape or, if necessary, very light scribing.

Face up one end on each of two short scraps of 3/8 in. dia. bar. Turn a (nominal) 9/64 in. spigot on one bar, a tight push fit in the bolt holes and a shade under ⅛ in. long. Leave this bar in the three-jaw and chuck the second piece in the tailstock drill chuck, faced side out. You can now hold the gland for forming the ends by sandwiching each end in turn between the two ⅜ in. bars. Either file the ends carefully, or plane them with a round-nosed tool set on its side, using very light cuts.

A final kiss with a file, a finishing cut across the face and there's your oval.

H. Wynne Williams



PISTON ROD GLAND: MOUNTING JIG FOR TURNING FLANKS OF "OVAL"

Hornsby locomotive

Sir,—I am collecting information to build a model of a Hornsby narrow gauge locomotive No. 1705, supplied in 1896 to Woolwich Arsenal. It was powered by a 9½ B.H.P. single cylinder Hornsby-Akroyd oil engine.

I have been in touch with Rustons of Lincoln, who have been most helpful, and have supplied such information as they have, but unfortunately all drawings seem to be lost. I am working from photographs and a page out of the ledger detailing the specification of the engine as supplied.

I wonder if any readers of M.E. remember this engine, or similar, and could supply information? I am particularly anxious to find out the clutch arrangement by which the load was taken up, and how this fitted in with reversing details.

I would be very grateful, if through your pages, I could establish contact with someone who knows about this engine. Over the years I have been surprised at what is known by M.E. readers, is it too much to hope that I will be able to fill in missing details from their knowledge.

34 Burnholme Drive, York. J. Burlingham.

J. E. McConnell

Sir,—On page 202 of today's issue of the Model Engineer, Mr. G. Limb says that James Edward McConnell was born in 1815 at Fermoy, Co. Mayo. Fermoy is in Co. Cork.

I lived in Cork, Kilkenny and Dublin from May 1910 to Easter 1916. I had occasion to visit Fermoy several times and passed through Fermoy Station many times.

Edinburgh. A. E. Hepworth

"Remembrance"

Sir,—As a 'Brighton' fan of some sixty years standing I was very interested in the pictures of the fine models shown at the Model Engineer Exhibition and am extremely sorry that I was unable to attend.

I see however that 'Remembrance' was resplendent in her deep umber livery. Now I seem to recollect seeing this engine shortly after she entered service in the early twenties in a sombre livery of light

grey in conformity with the solemn meaning of her name.

In case my memory may have been at fault I consulted Mr. Hamilton Ellis' "The London Brighton and South Coast Railway" wherein he says (pp. 209/210) "The engine was painted grey with black bands and white lining-out, white lettering and numerals blocked in black, and continued so until painted green by the Southern Railway."

Paignton. L. C. V. New.

Track Safety

SIR,—With regard to your recent appeal for information about Clubs and addresses of Secretaries, I enclose the membership list of clubs affiliated to the Northern Association and trust that these will be of assistance to you.

Recent letters in M.E. have made reference to the lack of communication between clubs, and riding car safety. Communication between clubs can be improved by joining one of the organisations such as the Northern Association or the Southern Federation of Model Engineering Societies. Meetings of the Northern Association of Model Engineers have discussed such topics as boiler safety and as a result there is now a common code of practice within the NAME for the testing of boilers with the award of test certificates. These certificates are accepted at all members tracks as proof of boiler test.

Riding car safety is currently being discussed and a sub-committee has made two interim reports. The consensus of opinion amongst NAME clubs is that an anti-tip rail should be high on the list of priorities in any club considering an intensive passenger hauling operation. However, expense is usually the criteria when building and clubs have trouble raising the cash to buy anti-tip material, and construct a track at the same time, but we would recommend that anti-tip rails should be fitted to elevated tracks where the riding cars run on 5 in. gauge.

We also recommend to our members that multiple car trains should always be run with the cars buffered up, or solid link couplings be fitted between cars to minimise movement between them. A rubber cover car to car should be provided over the couplings in the manner of corridor connections to prevent feet and fingers getting nipped as cars articulate round the track bends.

If more U.K. clubs were to join the various associations there would be greater opportunity throughout the model engineering movement for the circulation of ideas on a man to man, or even woman to man, basis. The riding car safety aspect is only one of many topics that will remain with us for some time and open discussion and the exchange of ideas is welcomed.

M. J. Heathcote
Honorary Secretary
Northern Association of Model Engineers

'Windmills'

SIR,—Re:—R. G. Selman's request (M.E. 21/2/75) for information. A very informative set of lecture notes compiled by Mike Cole B. Eng, M.Sc., entitled "Build A Windmill—A Feasibility Study" are available for £1 from Rother Valley College of Further Education, Dinnington Centre, Doe Quarry Lane, Dinnington Sheffield, S31 7NH. Cheques or PO's should be made payable to "Rother Valley Amenities Fund".

I am at present researching in this field and scheming around construction of a "Savonius" type vertical wind rotor with a heat generator for direct hot water supply. If R. G. Selman or any others interested will drop me a line I will be pleased to help in any way I can.

70, Devon Road,
Barking, Essex. P. G. Mackay

Small Lathe

Sir,—Readers may remember the small instrument lathe the writer exhibited at the Model Engineer Exhibition about five or six years ago for which a Commended certificate was issued. Perhaps they may care to know that a junior member of our Society, a sixth former of sixteen years of age at the Meridian School, Royston, is currently building a similar lathe taking the aforesaid lathe as a basic design and altering to his own taste.

A good deal of progress had been made on various parts, but the carriage has been completed to very exacting standard — Malcolm Wooster is a most meticulous worker and a photograph of this part is submitted for possible inclusion in our popular magazine.

It is hoped that the completed machine will be available for the next Exhibition—but it must be said that the lad's job is very much better as regards finish than his tutors (the writer).

Royston, Herts. W. Moor

IXL Lathe

Sir,—I have recently acquired for my home workshop a second-hand 5 in. × 24 in. IXL Invicta Lathe, which would be some 30 years old or more. A serial number stamped on the tailstock end of the bed is:

BBC M 23367_{14}

My problem is that some of the apron gears for both the longitudinal and cross traverse are missing and I cannot figure out what the originals were to affect a restoration. The clutch and gear for engaging with the lead screw and the hand wheel, hand wheel gear and the pinion for engaging the rack are intact as well as the small spur gear on the cross traverse, but in between is a void.

Any assistance readers can give will be deeply appreciated, either by way of a drawing, photograph, address of someone who has a similar lathe which is fully operational, or far more optimistically a catalogue of spare parts.

19 Toxburgh St.,
Stockton, N.S.W. 2295, Australia. B. A. Callen.

N.E.R. Compounds

SIR,—I am very grateful to your correspondents, including Mr. Griffinhagen who wrote to me direct, for giving the references to Nos. 730 and 731: I must spend a day at the Mech's Library getting some of them turned up. The inside/outside admission mentioned by Mr. Widdes reminds me of Dendy Marshall and LNWR *Prospero* and implies the use of a fixed ratio of HP/LP Cut offs as on Deeley's Compounds. What a pity the drawings were held back. Mr. Griffinhagen says the M.E. of July 22nd 1909 contained some; I wonder if anyone has a copy?

Hastings, Sussex. E. A. Langridge

CLASSIFIED ADVERTISEMENTS

Rate: 5p per word. Minimum twelve words 60p. Use of Box Number 25p extra. Display Classified Advertisements: £2.50 per single column inch (Column width 2 in.). Full particulars on application. Advertisements, with remittance, should be sent to Classified Department, Model Engineer, P.O. Box 35, Hemel Hempstead, Herts., at least four weeks before issue. Classified advertisements must be pre-paid.
The Advertisement Manager reserves the right to refuse or suspend advertisements without giving any reason. Every care is taken to avoid mistakes, but the publishers cannot be held liable in any way for clerical and printing errors or omissions. Receipt of "copy" for publication implies acceptance of these conditions by the advertiser. Whilst every care is taken to exclude advertisements from doubtful sources, no responsibility can be accepted by the publishers for the bona fides of advertisers.

WORKSHOP EQUIPMENT

OXFORD ARC WELDERS

Give you the full control of the welding current essential for quality welding from the thinnest materials upwards. No gimmicks—just properly engineered oil-cooled arc welders from **£46.** Free catalogue from:

C. G. & W. YOUNG (Oxford Welders),
Colne Road, Twickenham, Middx.
Tel: 01-894 5168 & 01-894 7767.

For sale. $6\frac{1}{2}$" × 24" Taylor plain lathe with chucks, no motor, £40, buyer collects. "Rob Roy" frames, stretchers, wheel and saddle castings, buffer beams etc. £5 Hotham, 46 South Park Avenue, Mansfield. Tel. Mansfield 34127.

Light machining: Turning, milling small components to customer's requirements. Tel: Loxwood 752536 Sussex. T.U.V.

Clerkenwell Screws Ltd.,

107/9 CLERKENWELL RD., LONDON, E.C.1. 01-405 6504

Welcome your enquiries for Brass and Steel Screws, Nuts and Washers

Prices on application. Price list not issued at the moment.

Brass-Bar, round, hexagon, $\frac{1}{4}$"/2" diameter up to 18" long. £1.30 KG. mixed. Aluminium alloy off cuts same price. 14G. brass sheet 4' × 2' £14. (£2 sq. ft.) Please add postage. Crew, Spinney Lane, Aspley Guise, Milton Keynes. T.

Drill chucks new. Lushington Precision Keyless 0-$\frac{1}{4}$ No. 1 Morse Taper £1.95 7/16 x 26 T.P.I. Female £1.63 including VAT. Post and packing 40p each. Molesworth Edwards, Greystones, The Hall, Martineau Lane, Fairlight, Hastings TN35 5DR. Tel: Pett 2426. T-C

Special Offer

40 New Dies, c/w Dieholder, many high speed steel (LAL, Clarkson, etc.) m/m, BA, BSW, UNF, UNC, BSF. **£5.00** set.

Set of new BA Taps and Dies, c/w Dieholder (LAL, Dormer Clarkson) 0 to 16 BA Taps, 0 to 12 BA Dies. List price £17, Our Price £4.00. P&P Free. Cheque with order to:

SMITH TOOLS
12 ARLINGTON COURT
ARLINGTON ROAD,
E. TWICKENHAM,
MIDDLESEX.

Excel instrument maker's plain lathe. Mandrel bored 1". Nose 1 9/16". Accepts collets, 3-jaw chuck, compound slide and T rest, countershaft. Buyer collects. Mount Elgon, Radfall Road, Whitstable, Kent. Tel: Chestfield 2413. £75 o.n.o. T.

Precision turned steel nuts, 8, 6, 9, 4 BA, 20p per 100, 3 & 2 BA. 24p per 100. OBA. 36p per 100. P. & P. 17p. C. Cooke, 68 Park Road, Enfield Wash, Middx. EN3 6SR. S-X

AUTHENTIC RAILWAY COLOUR PAINTS

The finest range of Authentic Railway colours available today. Our comprehensive list covers the majority of British railway liveries from pre grouping days to present-day B.R. colours. Send S.A.E. for list to:—

Precision Paints Company, P.O. Box 43, CHELTENHAM, Glos.

Trade enquiries welcome.

Available in Canada and U.S.A. from:—

Ontario Hobby & Craft, P.O. Box 940, Woodstock, Ontario, Canada.

Buck & Ryan for lathes and workshop accessories, drilling machines, grinders, electric tools, surface plates, etc. 101 Tottenham Court Road, London W1. TC

Wanted: Information on the Faircut Junior Lathe. B. Morehen, 26 Topham Crescent, Thorney, Peterborough. Tel: Thorney 389. T.

NUMBER DRILLS — H.S.S

Nos.	Price each	Nos.	Price each
1 to 4	32p	26 to 29	16p
5 to 8	27p	30 to 42	14p
9 to 12	24p	43 to 55	12p
13 to 25	21p	56 to 80	11p

Your own selection, min. order £1.50.
Full set Nos. 1—60, £10.50
Full set Nos. 1—60 in metal case £11.50

'BEDFORD' BA SPANNERS

Chrome vanadium sets in plastic wallets. 6 piece set, double ended rings 0 BA to 6 BA–£3.25. 5 piece set, double open ended 0 BA to 10 BA–£2.45.

All prices include VAT and P. & P. Complete satisfaction or mony refunded Cheque/P.O. with order.

MILLHILL TOOLS LTD., Steventon, Nr. Abingdon, Oxon, OX13 6SW.

Urgently required by retired modeller. Small motorised bench drill, $\frac{1}{4}$" capacity or less, also **small** bench milling machine, vertical preferred, but horizontal not refused, both can be in any condition as long as they work fairly true. Inexpensive as possible. Wise, 31 Randolph Gardens, Kennington, Ashford, Kent. Tel: Ashford 24852. (STD 0233). T

Myford Super 7, M.L.7 and M.L.10, Perfecto, Flexispeed and Unimat lathes and accessories, etc., export arranged.

Quotations given for purchase of complete workshops.

G. M. H. Bunce & Co. Ltd., 206 West Street, Fareham (4136)

Boxford lathe/accessories, offered in exchange for Model Locomotive. Tel: Bingham 37694. TU

PERFECTO

$3\frac{1}{2}$" x 16" B.G.S.C. centre lathes, 5" and 7" stroke hand and power shaping machines, vertical slides, vertical slide vices, $2\frac{3}{4}$" rough jaw vices, 3" plain machine vices.
Large envelope and stamp for lists.
Perfecto Engineering Co Ltd
Claymill Road, Barkby Road, Leicester. Tel: 0573-768384.

$1\frac{3}{4}$" Perris centre lathe motorised $\frac{1}{4}$ h.p. on baseboard. Faceplate. Centres. 3 Jaw. 4 Jaw. Tailstock chucks. Backgear. Autofeed fixed steady. etc. £75 o.n.o. 01-863 1920 (Evenings). T

Micrometers, Verniers, drills, taps, tips, cutters, lathes and millers at cut prices. S.A.E. for list. Graham Eng. Co., Oak Barn Road, Blackheath, nr. Birmingham. R-N Alt.

WANTED

Your complete workshop or surplus machines for cash

BRADLEY & GARLAND ENG.
44 Diglis Road — Worcester
Tel: 421110 evn., 355533 day

Myford Stockists. Accessories/Spares etc. For ML7/Super 7. Many ex stock including Vertical Slides. Latest lists/prices available. Small Lathes. Drillers. Grinders, etc. wanted for cash. L. Terry, Folly Road, Inkpen, Newbury, Berks. Tel: 048 84 331 (anytime). T

Workshop equipment for sale. Cost £120. Sell for £25. S.A.E. for list. Mrs. Cummock, 23 Clough Avenue, Woodheys, Sale, Cheshire. Tel: 061-973 1098.

SPECIAL FREE OFFER

Send 20p for our new lists offering many new bargains and we will include FREE a Precision File worth 70p. A limited quantity of Files still available also Gas Torch Kits at £9. Stocks of Imperial and Metric HSS Drills, Reamers, Silver Steel always available. P&P. No callers. Overseas orders extra 50p. **B & B (Dept ME), 17 Lingfield Road, East Grinstead. Sussex. RH19 2EX**

MODEL ENGINEERS PLEASE HELP. Lathe wanted. Just retired and setting up worshop. Fed up with offers of poor lathes at inflated prices by Dealers. If any brother model engineer has good lathe to sell please write: **J. McKee, 203 Malvern Road, Worcester WR2 4NW.**

For Sale. Portass $3\frac{3}{4}$" B.G.S.C. Lathe, complete with countershaft, motor 3 and 4 jaw chucks (Pratt) and face plate. Hardly used from new £100 or nearest. Apply D. R. Perry, Gorsemoor Road, Heath Hayes, Cannock, Staffs. T

COOKS OF BEDFORD LTD.
107 Midland Road
BEDFORD
Tel 59279

Stockists for

MYFORD
EMCOMAT
MAXIMAT
FOBCO

Full details on request or see these items together with a very wide range of tools and equipment at our showrooms.

For Sale. Hand shaper, 12" x 8½" automatic feed £38. 17 Lyndhurst Road, Corringham, Essex. Tel: Standford-le-Hope 5372. T

PORTASS LATHES

— Satisfaction guaranteed —

Please send stamp for lists to:
CHARLES PORTASS & SON
Buttermere Works,
Sheffield S7 2AX

Henry Milnes bench hand planer 7" x 17" table, mint condition. Best offer secures. Wood, 2 Burnt Hill Road, Farnham, Surrey. Tel: 21560. T

ARRAND LIGHT MILLING SPINDLE with built in 1/4" Collet Chuck.

ARRAND BALLBEARING SPINDLE with No. 1 M.T. Spindle bore.

Both these Spindles are suitable for milling and drilling in the lathe.

ARRAND SHEET METAL SHEAR cuts 10g. brass and 12g. steel. Designed for holding in a bench vice.

For technical leaflets and price list: UK enquiries please send 9"x4" s.a.e. Overseas enquiries please send International or Commonwealth reply coupon obtainable from your Post Office.

ARRAND ENGINEERING

32 Farmway,
Braunstone, Leicester LE3 2XA
Tel: Leicester 896025 (STD code 0533)

Myford ML10 3½" x 16" 3 jaw chuck, faceplate vertical slide, excellent condition £60. N. Sherlock, 5 Ophir Road, North End, Portsmouth. T

ASHDOWN MODELS

Lining tapes in a range of widths and colours. These are popular and save time and temper when finishing that work of art! Widths up to ⅛in. 72p each 3/16in. and ¼in. wide 86p each. New metallic finish in brass or chrome 80p each 1/64in, 1/32in. and 1/16in. only.

Why not let us paint and line your loco for you? Prices quoted on request. S.A.E. latest list to:—

ASHDOWN MODELS

"Witchwood", Blackness Road,
Sussex TN6 2NA. Phone: 089-26 4354.
Personal callers by appointment only.

MODELS AND MATERIALS

CHERRY'S

WE WILL PAY
THE BEST PRICES FOR MODELS ANYWHERE. WE REQUIRE MODEL LOCOMOTIVES FROM GAUGE "O" TO 10¼" TRACTION ENGINES, MARINE ENGINES, STATIONARY ENGINES, EARLY TINPLATE MODELS, BOILERS, ETC., ETC.

Single items or collections bought
Distance no problem
Write, call or telephone

CHERRY'S LIMITED
62 Sheen Road,
Richmond, Surrey, TW9 1UF
Telephone: (01) 940 2454

Pressure gauge 0-200 lbs. brass 6" dia. also ¼" h.p. Hoover motor fitted reversing switch. Offers to W. R. Brown, 20 Sutton Way, Heston, Middx. TW5 0JA. T

Sale Patterns, Compound Undertype Engine. Offers. S. Baines, 142 Brampton Lane, Darlington, Co. Durham. T

If you have a model to sell, consult STEAM AGE. Though specialising in Locomotives and Traction Engines we are interested in buying models of all descriptions.

STEAM AGE 59 CADOGAN STREET LONDON, S.W.3. Tel. No. 01-584 4357

3½" Bantam Cock £350. 3½" Ivatt "Atlantic", stripped for painting but complete £250. 7¼" lion (Titfield Thunderbolt) needs boiler £250. Compound condensing launch engine 1" x 2" x 2" £50. Stuart Sirius twin 1" x 1" £30. Double 5 A suit launch 20'/30' £90. All stationary engines machined but need fitting. Taylor, M.V. Iron Maiden, Stanilands Boat Yard, Thorne, Doncaster, Yorks. T

Wanted model steam crane. Box No. 3148 (Lancs). Model Engineer Office, P.O. Box 35, Hemel Hempstead, Herts. HP1 1EE. T

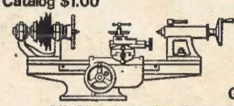
RAILWAY EQUIPMENT
For 3½" to 10¼" GAUGES

Complete sets of track parts, points, bogies, wagons, carriages, signals, etc. Electric, Diesel and Steam Locomotives. Railway planning and construction.
Send 20p for illustrated brochure.
CROMAR WHITE LTD.
"Mini Rail Centre", Durnsford Road, London, S.W.19. Tel: 01-946 1033

3" Lion Burrell traction engine and trailer for sale. £1400. Tel: Staverton 273 (Devon). S/T

Platform One will sell your models for you. 594a Fulham Road, (Kelverton Road), London, SW6 5NT. Tel: 01-731 3119. S/T/U

CALDWELL INDUSTRIES
LULING, TEXAS 78648
Catalog $1.00



Machine Tools
Steam Engines
Locomotives
Steam Tractors
Gasoline Engines

All M.A.P. Books Carried in Stock

Wanted to purchase by young model maker beginning, part finished model steam loco or boat. Good price paid. Please phone Cranleigh 4464. Surrey S&T

Ready-built Model Aircraft, Boats, Cars, also R/C gear, Engines, Steam Engines, Kits, Accessories, etc. Bought, Sold and exchanged. Tel: Godalming 21425. LNPRT

MODELS WANTED
OF ALL TYPES
Oakhill Museum, Oakhill Manor
Nr. Bath, Somerset
Tel: Oakhill 210

Pre-War "O" or "I" gauge model locomotive and coaches sought, made by Marklin, Bing, Lowke or Hornby, good price paid. Proctor, 10 Church Hill, Patcham, Brighton. Tel: 553940 Alt. T-C

Pressure Gauges ¾" and 1" diameters, S.A.E. for descriptive list. F. Dinnis, 3 Ward Avenue, Cowes, Isle of Wight, PO31 8AY. T-C

The "Steam Shop".

PEN-MODELS

366 KERR ST., OAKVILLE, ONT., CANADA.
(416) 844-6418

Reeves & Stuart Castings, Myford, Tools & Materials, etc. M.A.P. Books.

Cat. 6-74 $1.50

Also Boats, Planes, Trains Zg-'O'g
Plastics & Meccano
9-6 Mon-Thur. to 9 Fri., 5.30 Sat.

Poor old Jack, rotten verse. Can't get better, getting worse. (In bits:— 2½, B/L. GN Atlantic, Circa 1909). Offers. Box No. 3144 (Surrey). Model Engineer Office, P.O. Box 35, Hemel Hempstead, Herts HP1 1EE. T

SEE

SEVERN-LAMB LTD.

FOR -

The larger Locomotives — 7¼" to 2' 0" gauge.
Boilers
Museum and Scale Models
Animations

LEADERS IN THE MODEL WORLD

Severn-Lamb Limited,
Western Road,
Stratford-upon-Avon Tel: 3878

Hartop replica horizontal engine 1½ h.p. few available. Curwen, 22 St. John Street, Devizes, Wilts. T

1" scale traction engine believed to be Allchin. Cylinder, valve gear, front and rear wheels completed. Most of remainder of castings and blue prints available. £50 o.n.o. Thomas, 31 Rodney Street, Liverpool. T

WORRIED ABOUT YOUR
BOILER MAKING?
THEN TRY
JOHN SHORT LOCOMOTIVES
11 Sunnyview, Winkleigh, Devon, EX19 8HS
FOR COPPER BOILERS FROM
2½" to 7¼" GAUGE

4½ inch scale traction engine wanted. Tel. 061-980 5590. Mr. Lord kindly ring again regarding above. T/U/V/W

WANTED
Locomotives, Traction Engines, Steam Plants. Also Tinplate items. Best price given.
W JONES
295 WESTBOURNE GROVE, LONDON W11. Tel: 727 7051

Wanted: enthusiast anxious to purchase 5" or 3½" gauge locomotive, or 1½" scale, or larger traction engine. Any model complete or partially complete considered. Box No. 3145 (Derby) Model Engineer Office, P.O. Box 35, Hemel Hempstead, Herts. HP1 1EE. TUV

Wanted, 2½"/3½" gauge locomotive, any condition also rolling stock. Tel: Bingham 37694. TUVW

CLEAR PLASTIC MODEL COVERS
Send details and dimensions to Falconcraft Ltd., Hainault Road, Romford, Essex, for quotation. Phone: Romford 24621

3½" N.B.R. 4.4.2 Atlantic propane fired. Immaculate hard working engine. Completely overhauled, complete with re-fillable propane bottles. Photos. Pre-war oval shaped twin track 1¾" gauge track on base, points etc. Approx. 20' x 10' Box No. 3146 (Lancashire) Model Engineer Office, P.O. Box 35, Hemel Hempstead, Herts. HP1 1EE. T

Cast your own parts in white metal, aluminium, brass or bronze, by "Lost Wax Castings". Full range of materials and equipment, with full instructions. Manufactured and supplied by:
CRAFTS AND KILNS
376 FINCHLEY ROAD., LONDON, NW3 7AJ Telephone 01-4356354

For sale 3½" gauge, 0-6-0 Iris, boiler complete, chassis 85%, materials for tender, cash offers around £100. Walker, 15 Park Lane, Retford, Notts. T

5" gauge fine scale bullhead track parts for sale. Suitable for display or passenger traffic. Weatherproof. Foolscap S.A.E. for list. 50p for sample parts. Martin Engines, Thame Road, Haddenham, Bucks. Tel: Thame 2082. T-C

Wanted, 5" gauge Virginia or part finished model. Also beam engine, Stuart, M.E., etc. boiler for 5" Firefly Tel: Coalville 32008 or write, Main Street, Ravenstone, Leicester. Q-T

BOOKS & PUBLICATIONS

NON-FERROUS CASTINGS
To your Specifications for quotation
Send drawing or sample.
I. & M. CHAPMAN
24 Almond Crescent
Mastin Moor,
Chesterfield, Derby.

M.E bound Vols. 80-89, £2.50 each. Watson, 1 Badgebury Rise, Marlow Bottom, Bucks. T

Wanted copies of "Model Enginer' any dates 1910 to 1929. Loxton, 5 Church Terrace, Tylorstown, Rhondda.

DON YOUNG DESIGNS
Drawings for 14 Locomotives including:-
2½ in. G.
Elaine or Sir Ironside at £4.
3½ in. G.
Mountaineer at £7.20; Derby 4F at £4.00; County Carlow at £4.80.
5 in. G.
Rail Motor No. 1 at £4.80; No. 2 at £4.00; Jersey Lily at £9.10; B.R. Class 2 Mogul at £4.40 — Wheel, Cylinder, Chimney & Dome castings available to orders for Class 2 only.
Send 12p for Catalogue No. 5 to:—
Bardonela, Adgestone, Sandown, I-o-W, PO36 0HN.

Wanted to exchange 380 M.E., 300 Mechanics. For equal number M.E. pre-1926, Mechanics pre-1945 or Pultra lathe equipment. S.A.E. particulars. Box No. 3147 (Devon) Model Engineer Office, P.O. Box 35, Hemel Hempstead, Herts HP1 1EE. T

Model Engineer/collector requires clock and watch books, also books on turning, plain, ornamental, and geometric. Particularly Savory's "Geometric Turning" and "Manuel Du Tourneaur" by Bergeron. J. M. Wild, 12 Norton Green Close, Sheffield 8. Tel: 745693. TU

Wanted. Bound volumes of Model Engineer in good condition. Volumes 1, 36, 37, 38, 39, 40, 41, 42, 43, 119, 120, 124, 125, 132. Offers please to the Editor Model Engineer P.O. Box 35, Hemel Hempstead, Herts HP1 1EE. T/C

Model Engineers Bound and unbound volumes, individual and indexes bought and sold. Write enclosing S.A.E. to M.E.S.P.S., 216 Coventry Road, Hinckley, Leicestershire LE10 0NG.

£80 "minimum" offered for M.E. volumes 1-80 (portions welcomed, available). Lambert, 60 Salhouse Road, Rackheath, Norwich NOR 01Z. Q-D

Rare locomotive prints by Frederick Colyer 1885. Stirling Single £2.50. Frank Brown, 55 Baldocks Lane, Melton Mowbray, Leics. Tel: Melton 4663. O-T

PHOTOGRAPHY

"Projector Kits". Tax free model kits for combined 2 in. x 2 in. and 2¼ sq. slides 25mm, stereo. View-Master reels, projectors viewers, microfilm, readers, overhead projectors, screens, Episcope kit (5 in. x 5 in.) £16.80. Opticals, fan motors, lamps. S.A.E. for brochure stating interest. Marshall Smith Ltd., 64 Norwich Avenue, Bournemouth. T-C

GENERAL

SIMEC
STUART INTERNATIONAL MODEL ENGINEERS' CLUB

Announces an important new series on building the STUART No. 1 Engine. Specially written for the beginner and fully illustrated. Part 1 will appear in Newsletter No. 21, due out in May.
For details of membership write to:—
The Secretary (SIMEC), 54 Berkshire Road, Henley-on-Thames, Oxon., RG9 1NA.

1950 Corgi scooter, rebuilt and in excellent condition. Practical economical transport and fun at shows. £65 or consider exchange moped or workshop equipment. Tel: Chesham 71394. T

16mm Cine film wanted of British steam locomotives before 1964. Martin, 4 Linton Road, Tyseley, Birmingham. S.T.U.

Ball races (caged SKF) Special offer to clear—9mm i/d x 24mm o/d 10mm. Four races £1.00 inc. VAT & post Harry Butler (Models) Colchester Road, St. Osyth, CO16 8HR. T/C

Penfriends Home and Abroad, S.A.E. for details European Friendship Society, Burnley, Lancs. T-C

ELECTRICAL

Two speed 690/1390 r.p.m. 3 phase motors with brakes ½ h.p. £14. Ditto 1400/2800 r.p.m. £10. Rycroft, Scarr House, Stainland, Halifax. T

Dynamos 6 volt 5 amp D.C. with battery cut-out, clock/anticlock £5.25, can also be used as powerful 12v motor. Rectifiers F/W bridge 100v 20 amp £3.25. Indicator lamps panel mounting M.E.S. 25p. Transformers 240v 0-9-17v 2 amp £2.25. Transformer, 16v 20 amps or 30v 10 amps £9.25. Malden Transformer, 134 London Road, Kingston on Thames. Tel. 01-546 7534. T

7—½ h.p. motors 24/28 volts D.C. 7400 r.p.m. £12 the lot. Tel: Tottington 4712 (Lancs). Buyer collects. T

RALLIES

The National
2½ INCH GAUGE RALLY
at CHELTENHAM
on SUNDAY 4th MAY 1975
Have you considered 2½ inch gauge? Did you know drawings and castings exist? Come and see it in operation. Everyone welcome. Free admission.
The track will be signposted from the A40 junction with the M5 (junction 11).
Bristol & Cheltenham Societies of Model & Experimental Engineers

Model Engineer is printed in Great Britain by Thamesmouth Printing Co. Ltd., Southend-on-Sea, for the proprietors and publishers, Model & Allied Publications Ltd., (a member of the Argus Press Group) 13/35 Bridge Street, Hemel Hempstead, Herts. Trade sales by Argus Distribution Ltd., 12/18 Paul Street, London, E.C.2. to whom all trade enquiries should be addressed.

M.E. QUERY COUPON APRIL 1975